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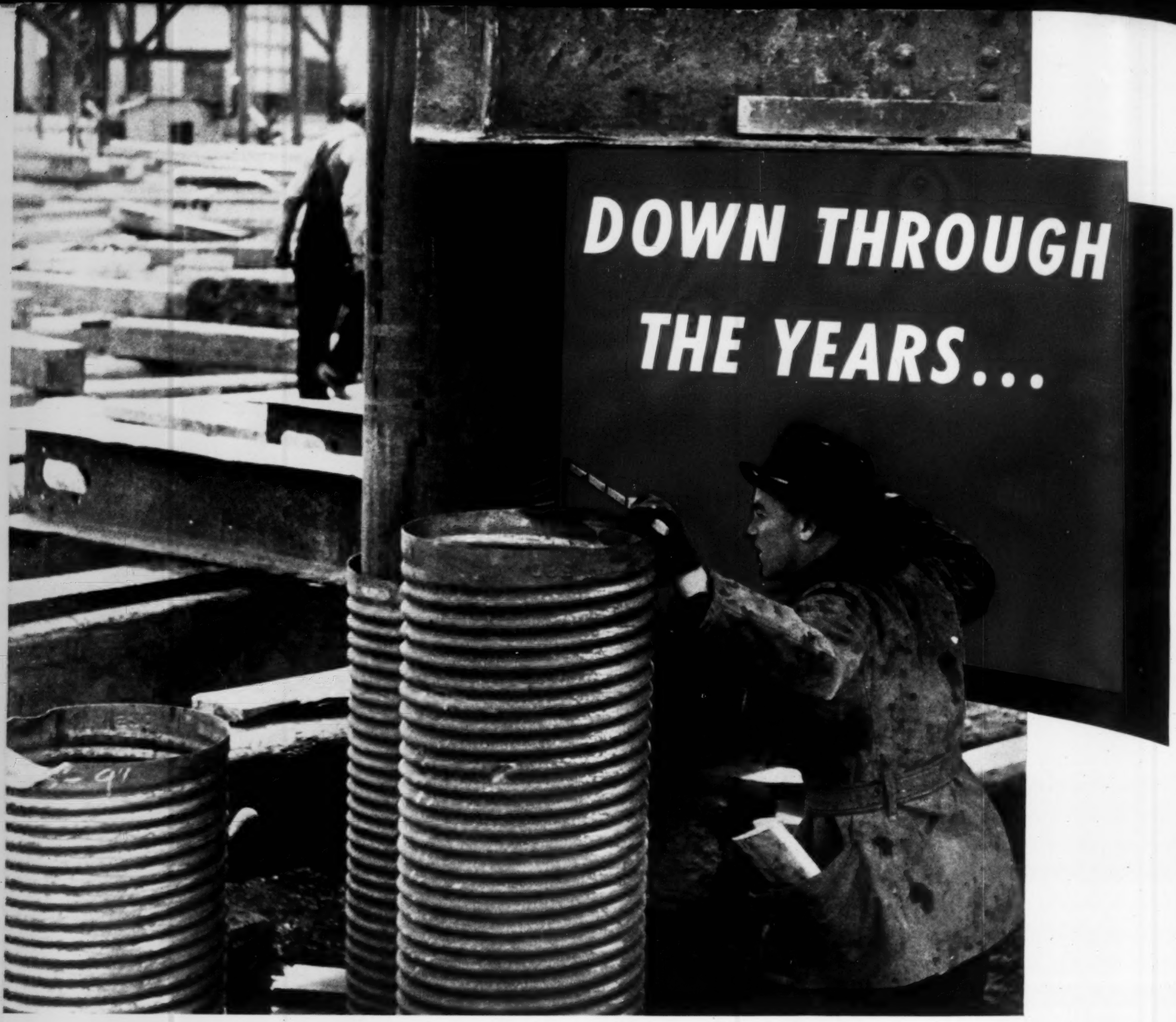
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Something to Think About

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The Greater Future of Engineering

By FREDERIC BASS, M. AM. SOC. C.E.

CONSULTING ENGINEER; HEAD OF CIVIL ENGINEERING DEPARTMENT, UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINN.

IT is the business of engineers to measure. They measure things, forces, time, and men. Their measurements never, except by accident, are perfect; they are approximations, the degree of error depending upon the nature of the measurement and the care with which it is made. Their measurements are based on standards, more or less arbitrarily chosen, yet permanent in the midst of changing practice, personnel, and human affairs. Engineers measure their tasks by many standards so that they will be fitted to their purpose with the least expenditure of material, time, and energy; that constitutes planning. Engineers are exponents of conservation, enemies of waste; they are constructive. What chance have they in a world of wasteful men, seemingly bent upon destruction?

Blinded by Easy Wealth.∼For three-fourths of a century, the people of the United States have enjoyed an almost uninterrupted advance in wealth and luxury. They have been so engrossed in the development and exploitation of hitherto unknown natural resources and so sure of the indefinite continuance of these resources that they have been blinded to the aspirations and aims of other nations and races for world domination. They have been ignorant of the extent of the actual preparations for far-reaching conquest which these nations and races have made, particularly in the last decade.

They have occupied themselves with internal dissension, partly over the distribution of wealth and partly over inconsequential or even illusory issues. Their interest in foreign affairs waned while their zeal to produce two chickens in every pot and two cars in every garage waxed great. Preoccupation with internal affairs precluded attention to destructive external forces that were planning both for an immediate and for a distant future.

Their governments have concerned themselves largely with the means of perpetuating themselves in office, as perhaps all governments must do, but so great has been their anxiety in this direction, and so great the din of their vocal expression, that the rumble of the approaching storm has been audible only to a few, and these few were shouted down as war-mongers.

Theorists Out of Date.∼The storm has now burst upon us with such fury that it cannot be talked down. Government that has but one front—political—must transform itself into one with three fronts—military, economic, and political. It must concern itself with facts as well as theories. Isolationists, pacifists, socialists, communists, democrats, republicans, industrialists, capitalists, laborites, humanists, and other "ists," "isms," and "ites," must all sacrifice their fond hopes for their own particular groups and give their unqualified support to their country. Otherwise they will each and all become slaves of the conqueror.

The day has come when effective production and effective use of resources must prevail. The utmost efficiency in military and economic activity is required from every man and every organization. Sooner or later in this conflict the relatively petty rivalry for power or advantage between men or groups will be subdued. It can come sooner if it is voluntary, but it will come later by compulsion and necessity if not now by voluntary action. Come it will. Let us hope that it comes before defeat. It alone can avert defeat, and it will certainly follow defeat if defeat comes—and in such a form that we cannot realize its horrors.

No Easy Victory.∼The pay check is important, but the work to be done is more important. If the people can believe this, pay checks will continue. The penalty they will pay for disbelief is slavery under ruthless and savage masters.

For some months now, the people of this country have, in spite of the apparent developments of the war, felt secure in the ultimate victory of the Allied forces, and within a few years. They are not facing the facts of the situation, which are that the Japanese, a few months ago in possession of greatly inferior resources, now after a brief campaign have access to many resources which are equal or superior to our own, particularly with respect to rubber and important metals; and they have a sufficient food supply. They conceivably and quite possibly may alienate or isolate the 800,000,000 people of India and China and they may divert Russia to some extent from the Nazi threat, which has not diminished.

All this adds up to the prospect of a long, long war, perhaps a war without definite victory for either side, or a long period of desultory military action, each side preparing to exploit any and all weaknesses of the other, whether military, economic, or political. Even in the event of an allied victory, destitution will be world wide, confusion will prevail, and the economic burden will tax the utmost resources of men and materials. In the final adjustments, which may extend decades into the future, those nations which have their potential resources in dynamic form, that is, ready for quick action, will prevail.

"Divided We Fall."~Men who know world conditions and understand their significance will be in power; political theorists will have disappeared. Men of understanding, with authority, capacity, and will for action will compel the people who survive to accede to such control. If the United States is to survive this conflict, the political power of blocs and groups in its legislative halls, power used for bloc economic advantage, must and will be destroyed even if the country must be placed for a time under military-economic control.

With the enemy having equal resources, carefully planned for military use and 70% devoted to military purposes, how can we, with 50% so devoted, hope to win? Either a greater proportion must be directed to military ends or such as are devoted must be used with a greater efficiency than those of the enemy.

Man power alone cannot meet the situation, and each single unit of man power, each individual, must out-work and out-fight that of the enemy. Eventually the pay-check standard of measurement must give way to the output standard. Efficiency requires thought and physical stamina. Efficiency means clearing the decks for action from criminals, traitors, and defectives, all of whom must be placed to one side and properly isolated and cared for. This means universal registration of all individuals and the assignment of all to appropriate stations, locations, or tasks, which in turn means an appraisal or personnel system not yet envisaged. It means the sacrifice of a small measure of personal liberty as a protection against its total loss under a conqueror.

"Isolationists" No Longer Isolated.~Not by any possibility can any thinking person look forward to a renewal of the easy-going, wasteful life of the first four decades of this century. The so-called "American way of life" is not going to be preserved! It is going to be radically changed, no matter what the outcome of the war may be. No longer can we remain undisturbed by "foreign wars"; there is no such thing as a "foreign war." The world, owing to technological development, has a new tempo or time standard; swift communication and transportation have brought its hitherto separated areas almost in contact; oceans no longer isolate its continents.

Our humanitarian standards do not rule foreign lands, where long-continued destitution, famine, and dispossession have engendered savage hates and where human life has little value. We can no longer live apart from these; we must recognize their existence not only as things of the present, but as an inheritance from unmeasured antiquity, passed down the ages from animal-like ancestors, and a thing from which we ourselves are not yet free. These hates and fears will not be soon overcome, not for centuries. Until they are, wars will recur and consequently military protection must be maintained from now on.

It is true that while modern science has made world war possible, it has also made it possible to produce sufficient food, clothing, shelter, health, and comfort for the entire population of the world. This is the promise of the future, awaiting the evolution of human intelligence to a point where human society can be organized on the basis of true economy—the economy of saving, conserving, and developing the most precious resource on earth, that of human life and the human spirit. This is the promise of the embryonic democracy thus far achieved and a promise that can be realized by years of work and sacrifice, in a period now beginning.

Age of Conflict Dawns.~In this period, a new age in human history, one of conflict and adjustment, efficient and economic planning and use of resources in men and materials will ultimately prevail. These are inherent in the character and significance of engineering and technology. Upon them will depend not only the military victory but the stability of the reconstructed society to follow.

The struggle we are now beginning will determine whether the new material wealth created by engineering and technology, adequate for the necessities of all mankind, shall be used for the benefit of the few or for the welfare of all; whether mankind shall stagnate in an atmosphere of hate and suspicion or whether we shall gain ever-new life in the air of freedom; whether like animals under compulsion we shall be racially static, or whether under freedom we shall grow in wisdom and understanding from generation to generation.

Engineering and technology work for both sides in this struggle. One side has no rules or principles; it is operated by the whimsies of individuals and by deceit; it can have no inherent internal cohesion. The other side is governed by the ruling motive of promoting human development, a constructive ideal of victory and survival. Ultimately it must conquer because it is the agency of the invincible human spirit of progress.

Beyond Technology.~Engineering and technology partake of the spirit of progress, of pioneering, and of research seeking to discover the principles of, and the way to progress. As engineering is destined to become one of the great agencies of social progress, it logically follows that engineers, if they are to think and act with maximum efficiency, must look not only at, but beyond their materials and technical methods. They must see the character and meaning of the responsibility which fate has laid upon them—the responsibility to extend the beneficent power of science and technology, not to the few, but to all the people, calling forth and directing their latent energies in helping to build a true democracy, founded upon that ultimate economy, human welfare. The recognition and acceptance of this accountability is already evident in the increasing infiltration of engineers into positions of influence in industry and government. Pioneers in planning based on the measurement of things, forces, time, and men, they are fighting for freedom, now and for the future.

As the greater meaning of engineering is envisioned in the councils of engineering organizations and is there translated into practical policies for the education of the membership, engineering leadership will become identified with beneficent statesmanship. It will render to a waiting world the superior service of which it is capable, and will earn respect and gratitude beyond that now due or hoped for.

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Track Problems in Operation of Streamliners

By H. B. CHRISTIANSON, ASSOC. M. AM. SOC. C.E.

DIVISION ENGINEER, CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC RAILROAD COMPANY, SAVANNA, ILL.

SINCE their introduction only a few years ago, streamlined trains have been a boon to railroad traffic. That they are here to stay is obvious from their continuing popularity and extension. But they have also brought with them problems of maintenance due to their unprecedented speeds. Mr. Christianson shows the need of greater care in track work and especially in reducing curvature. Straightening alinement, he states, is at present the biggest source of benefit in operating streamliners. This paper originally was presented to the Tri-City Section at its meeting on February 20 in Davenport, Iowa.

ONE of the greatest advances—perhaps the most significant—in modern rail transportation has been the development of streamline trains for passenger service. What this has involved from the standpoint of track maintenance will be made more clear from a brief review of the history of railroad way structures. This naturally will lead to a consideration of present problems and the methods of attacking them. In this discussion I may be excused for quoting from the practice of my own company, the Milwaukee Road, and the features of its own streamlined trains, the various "Hiawathas," for these are the only experiences about which I can speak with certain knowledge or authority.

Well over one hundred years ago—in October 1829—the directors of a proposed rail line between Liverpool and Manchester, England, staged a contest between four locomotives weighing from $4^1/_2$ to 6 tons each. The "Rocket," built by George Stephenson, alone completed the run; it fulfilled all the conditions set forth by the directors, attaining a speed of 35 miles an hour. This performance of the Rocket established the practicability of rail travel and started the revolutionary development of railroads on its way.

Even in America the impact was felt. In 1830 the newly organized Baltimore and Ohio Railroad began making tests to determine the relative merits of wooden cross ties and stone sills. It found that the wooden ties made far better track than the more expensive stone sills. In a very short time rolled iron rails similar in cross-sectional shape to our present much larger steel rails came into general use. The need for ballast to distribute the superimposed loads evenly over the subgrade soon became evident as did also the necessity for drainage in the form of side ditches in cuts to prevent softening of the roadbed.

IMPROVED IN DETAIL, NOT IN PRINCIPLE

Today the track structure is substantially the same in basic plan as it was a hundred years ago. The great progress that has taken place has been primarily in improving and perfecting the design of the various parts of the track—in using ever stronger and better materials, in adding the many appliances that the heavier and faster traffic has shown to be needed, and in utilizing power-driven tools and equipment to make for better, more uniform, and more economical workmanship.

This strengthening process has gone on steadily since the beginnings of the railroads. As an example, some of the lines which now form part of the Milwaukee Railroad were built about the time of the Civil War, when 60-lb rail was considered heavy for main-track use. Now our main lines, from Chicago to the Mississippi River west of Savanna, Ill., and from Chicago to Milwaukee, are laid with 130-lb and 131-lb rail; and the trunk line continuations from those points are being relaid with 112-lb and in some cases with 131-lb rail.

All parts of the track structure have been strengthened along with the rail. Untreated ties have given way to creosoted. In fact on most of our railroad only hardwood creosoted ties are used. They are bored through at the spike locations before treatment and also are preadzed where the tie plates will rest. Tie plates for all the new main-track rail are of the double-shoulder type. They are anchor spiked to the tie to prevent as far as possible abrasive action of the plate on the bearing sur-

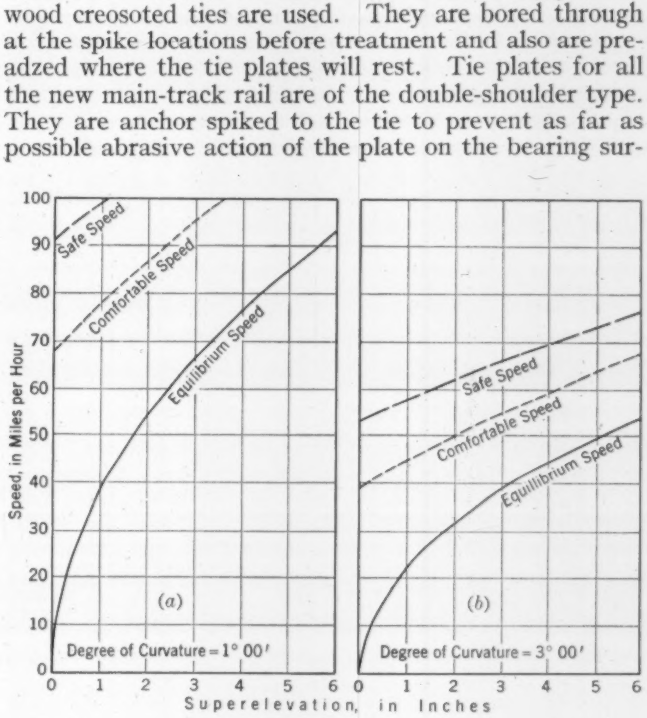


FIG. 1. SAFE, COMFORTABLE, AND EQUILIBRIUM SPEEDS ON VARIOUS CURVES

REALINEMENT TO REDUCE CURVATURE NEAR KIRKLAND, ILL.
Old 1° 50′ Curve Is on Right, While New 1° 0′ Curve with Track and Ballast Partially Applied Is on Left

face of the tie. On sharp curves, where the lateral thrusts tending to spread the rails are the greatest, two rail spikes are driven on each side of the rail. On tangent track one rail spike on each side suffices. All of them, including the anchor spikes, serve to resist the lateral pressures. Thus the danger of spread track has virtually been eliminated.

Switch construction has been made much stronger than it was a few years ago. Lengthened turnouts have permitted increased speeds through them at the ends of sidings and main-track connections. Installations of subgrade drainage in the form of vitrified tile or perforated wrought-iron pipe have been made over a period of many years under careful engineering supervision, and the results have been for the most part very gratifying.

There is only space to mention a few of the other operations which have contributed their share to the improvement of track conditions. Among them may be noted the Sperry method of detecting transverse fissures in the track; the building up of battered rail ends in track by the welding process, as well as the repairing of turnout and crossing frogs by that method; the hardening of rail ends to reduce batter; the controlled cooling of newly manufactured rail (which, so far as can be seen now, has entirely stopped the formation of transverse fissures); and the general use of mechanized tools and equipment covering practically every operation in large-scale rail and ballast work.

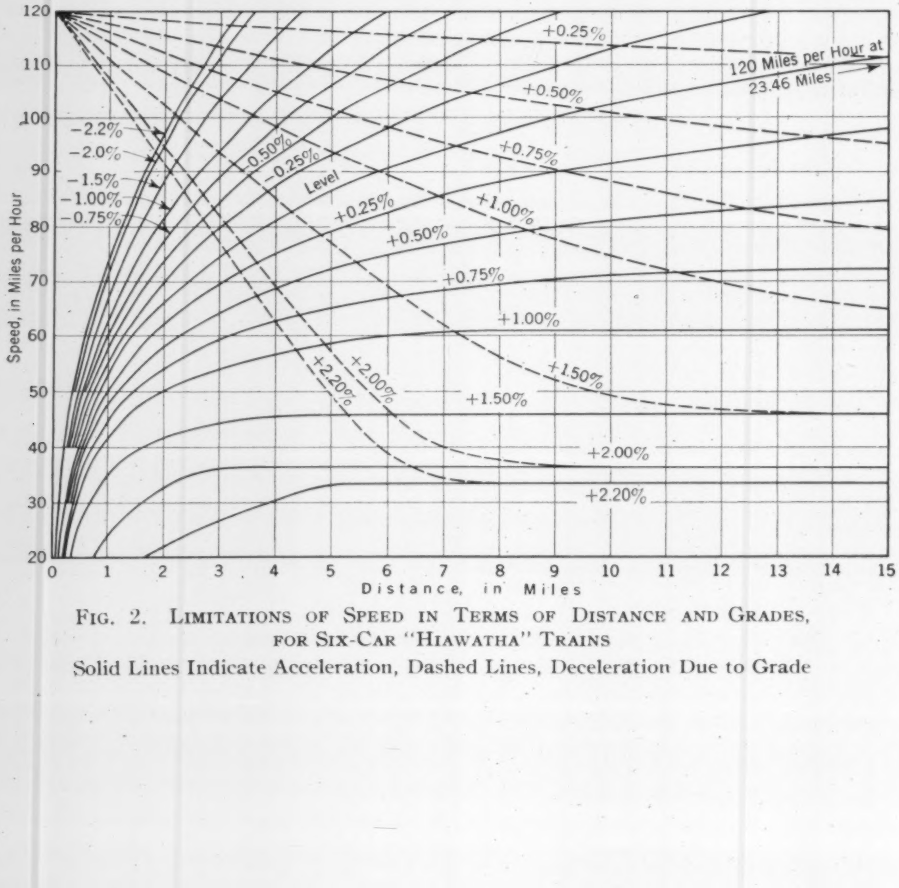


FIG. 2. LIMITATIONS OF SPEED IN TERMS OF DISTANCE AND GRADES, FOR SIX-CAR "HIAWATHA" TRAINS
Solid Lines Indicate Acceleration, Dashed Lines, Deceleration Due to Grade

In large part the progress that has enabled the railroads to take on the streamliners in their stride has been due to the standard plans, designs, specifications, and accepted practices recommended by the American Railway Engineering Association, an organization composed of engineering employees and officers of American railroads. The railroads themselves have cooperated with the Association and have given assistance in lending the use of their facilities for the making of numerous tests. Especially notable have been the researches of the Joint Committee on Stresses in Railroad Track in which the Society has cooperated, under the successful chairmanship of the late A. N. Talbot, Past-President and Honorary Member.

RAIL-LAYING MACHINE INSTALLING 131-LB RAIL NEAR LEAF RIVER, ILL., REPLACING OLDER 100-LB SECTION

JUSTIFYING ADDED COSTS

As far as maintenance of the existing structure was concerned, the problem presented by the streamliners was answered chiefly by taking more care in smoothing the track and keeping it smooth, so as to insure comfortable riding. Roadmasters and section foremen soon learned that they had to tend to low spots that appeared in the track sooner than they had done previously. In winter, track that heaves as little as $^{1}/_{4}$ in. out of level or surface creates a noticeable rough spot under the streamliners when the change is abrupt. Track foremen correct this difficulty by inserting graduated shims under tie-plates on several ties adjacent to the high point so as to lengthen the distance from it to the lower elevation of the normal rail surface, thus making the changes in movement more gradual. Previously such spots might have gone unnoticed with no injurious effect to track or riding qualities.

Nearly everyone connected with the maintenance of such track soon becomes what we call "spot conscious" and makes every effort to discover and correct small irregularities in surface and line before supervisors and officials point them out. We aim to have the section foremen ride the streamliners once a month in each direction over their own and neighboring track between regular stops, to acquaint them with riding conditions. Maintenance of track to accommodate the streamliners means additional cost because of the higher standard of track smoothness which must be maintained. Authorities have estimated the additional cost to be about 25%; in my opinion that estimate is conservative.

At the end of 1941 there were a total of 125 streamlined trains in the United States which have average speeds of sixty miles or more an hour between terminals and which put approximately 77,000 miles behind them every day. Thirty-six new trains were added during the year 1941—this exceeded the number put on in any previous year since the service was first inaugurated in the fall of 1934. The afternoon Hiawathas between Chicago and the Twin Cities set a new record for themselves by carrying, in August 1941, a total of 38,472 revenue passengers; the morning Hiawathas were carrying 22,456, making a total of 60,928 for the two trains during that one month. The increased cost of track maintenance apparently has justification when business is attracted to streamliners in such volume.

ALINEMENT IS MOST IMPORTANT

However, the controlling factor in the operation of fast trains is not track maintenance—it is track curvature. I believe that the tangent track on our main line from Chicago west to Savanna is safe for whatever speed the present streamlined engines are capable of making. On the other hand, curves as flat as 1° have definite speed limitations. For instance, the superelevation of $3^{1}/_{2}$ in. on such a curve permits a speed of 99 miles an hour. Speeds in excess of that call for more elevation; and since our Milwaukee rules do not permit more than $3^{1}/_{2}$ in. except in special cases, our 1° curves limit speeds to less than 100 miles an hour.

There is an upper limit to the amount of elevation that it is practicable to put into a railroad curve. Nearly everywhere freight and passenger trains operate over the same tracks. When the elevation is excessive for a relatively slow-moving freight train, there is a concentration of weight on the low side, and for this reason there is a tendency for the low rail to settle. This greatly increases the expense that is necessary to maintain proper surface and specified elevation. Experience has also taught us that a freight car moving at a slow speed around a curve elevated for a much higher speed has a tendency to climb the high rail. Irregularity in the track surface or elevation may cause the car body to rock far enough to the inside to cause the wheel on the high side to be raised, permitting the wheel flange to get on top of the high rail. We know, also, that excessive elevation produces much greater wear and flow of metal on the low rail.

Revision at Kirkland, Ill., Looking Along Old Line
New Alinement at Right; Old Twin-Deck Girders in Middle Distance Are to Be Moved Over to New Location on Falsework, as Shown

Power Adzing Machines at Work
Operation Preparatory to Changing from 100-lb to 131-lb Rails

The lowest elevation that will still afford comfortable riding at a given speed has been found to be 3 in. less than that required for equilibrium. The equation for this condition may be expressed as

$$\text{Elevation in inches} = E = \frac{V^2D}{1{,}500} - 3$$

in which V is the speed in miles per hour, and D the degree of curvature. The speed conforming to this equation has been designated as the "comfortable speed," and it also has been adopted by railroads generally as the maximum permissible speed. Experience has shown that limiting safe speeds are considerably below the actual theoretical overturning speeds. The so-called "safe speed" has been found to be that which produces a resultant force that passes through the outside edge of the middle third of the track, assuming the center of gravity of the car to be 84 in. above the rail.

PLANNED SCHEDULES FOR TRAIN SPEEDS

The graphs shown in Fig. 1 illustrate the speeds for conditions of equilibrium, comfortable riding, and limit of safety up to a maximum elevation of 6 in. for curves of 1° and 3°. A curve of 30′ has no speed limitation as far as any present-day speeds are concerned. Inspection of the chart shows that the more the curvature the nearer the lines are to each other, and that on each graph the lines converge as the speeds and elevations are increased.

It will be noted (Fig. 1*a*) that for a 1° curve and a $3^{1}/_{2}$-in. elevation, the comfortable speed is 99 miles an hour. The safe speed, which is shown above the limits of the chart, is $116^{1}/_{2}$ miles an hour, a difference of $17^{1}/_{2}$ miles an hour. For a 2° curve and a $3^{1}/_{2}$-in. elevation, the comfortable speed would be $70^{1}/_{2}$ miles an hour and the safe speed, 82 miles an hour, a difference of $11^{1}/_{2}$ miles per hour. With a 3° curve (Fig. 1*b*) at a $3^{1}/_{2}$-in. elevation, the comfortable speed is 57 miles an hour and the safe speed is 67 miles an hour, a difference of only 10 miles an hour.

There always is the possibility that an engineman will exceed the permissible speed for one reason or another, in spite of the fact that speeds are recorded on tapes every trip, and sent in to the office of the Superintendent of Motive Power, where they are checked and compared with master tapes. Sharp curves therefore present a very serious obstacle to the operation of streamliners, aside from the fact that valuable time is lost from the moment braking action begins until normal speed is again reached. Such braking is also destructive to materials and wasteful of fuel.

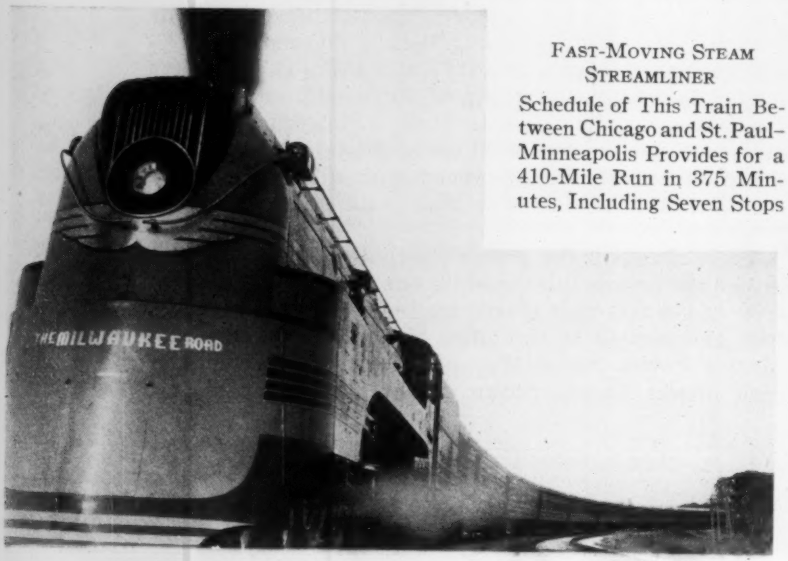
Another problem in connection with the operation of streamliners is the preparation of the schedules. First, a theoretical schedule is set up in the engineering office. In this all the restrictive conditions are taken into consideration, such as curvatures, gradients, stops, and arbitrary slow-downs as at some railroad crossings or through large towns.

Information is available in the form of tables and graphs for various sizes of locomotives and train lengths from which travel time can be obtained. One set of curves (Fig. 2) gives the maximum speeds attainable in corresponding distances for various descending, ascending, and level grades. A table gives the average speeds under conditions of acceleration or deceleration. Another table gives the maximum acceleration and service deceleration distances for all combinations of speeds, and so on.

After the proposed schedule has been prepared and before the new run is actually inaugurated, a test run is made during which a complete log is kept, including the time in seconds when passing each mile post and station; also the stopping and starting time for each stop. Before the test run, all curves that restrict speed are posted with standard-speed signs 3,000 ft in advance of the entering ends, and appropriate signs are placed to denote where speeds can be increased. After the test trip, the timetable is prepared; and it is surprising how closely it agrees with the original tentative one.

The flattening out of restrictive curves is one of the big problems the streamliners have presented to us. On our division, for instance, between Bensenville Yard, Chicago, and Savanna, where the Midwest Hiawatha runs, there are a number of curves sharper than 1°. In 1941 we went to work on one stretch and relocated four double-track curves which gave us 38 consecutive nonstop miles east of Davis Junction with 1° maximum curvature. This work involved the relocation, at a cost of about $80,000, of $2^{1}/_{3}$ miles of double-track railroad, the shifting of a steel bridge under traffic conditions, and the making of temporary track connections because of new and old line crossings.

Work of this same nature was done at a great many other places on our railroad last year. It went on, but to a much lesser extent, even in the lean years beginning with 1934, when the curves along the Twin City Hiawatha route were first prepared for high-speed train operation. Curve reductions have also been effected by other railroads throughout the country. Some, notably the Santa Fe, have done such work very extensively.



FAST-MOVING STEAM STREAMLINER

Schedule of This Train Between Chicago and St. Paul–Minneapolis Provides for a 410-Mile Run in 375 Minutes, Including Seven Stops

OBSTACLES TO SPEED OF STREAMLINERS

Combination of 3° 30′ Curve and Turnout Reduces Allowable Speed of Midwest "Hiawatha" to 40 Miles per Hour at Kittredge, Ill.

In addition we have made surveys and prepared estimates of cost at 15 other locations. It is possible to compute very closely the time savings, in seconds, that the flattening of a single curve or a combination of curves will effect. Then by comparing the estimated costs of the various proposed improvements with their corresponding time savings, a program can be worked out that will allocate the available money to the very best advantage and in conformity with a long-range plan.

WHERE SAVINGS ARE MOST BENEFICIAL

Improvements in alinement are the most fruitful field in which to work to shorten schedules at the present time. Only 4 seconds can be saved in a mile by running 100 miles an hour instead of 90 miles an hour, and but 3.3 seconds more by running at 110 miles an hour. On the other hand, reducing speed from 90 miles an hour to 55 miles an hour, which is the permissible speed around a 3° curve, and building up again to 90 miles an hour, loses 47 seconds in running time and requires 5.8 miles for our present Midwest Hiawatha trains. The time lost going at the slow speed around the restrictive curve, if it is one-half mile long, is 13 seconds more, making a total loss of one minute.

Curves of 3° built in track 50 or 60 years ago did not restrict the operation of trains in any way. It is remarkable that the original alinements are as good as they are. It would be beyond all reason to expect the early railroad builders to see ahead to the time when 1° curves would be restrictive; and even if they had been able to do so, it is very doubtful that the means would have been available with which to do differently from what they did.

Another problem is one which the streamliners did not originate but which they did bring into much sharper relief. It is the avoidance of slow track wherever possible in connection with maintenance and construction work or for any other reason. Work has to be planned and supervised more carefully than ever before to keep the trains moving with the least possible delay, keeping in mind at all times the matter of safety in train operation. It goes without saying that civil engineers are attacking these and all other problems connected with this modern means of locomotion with their characteristic thoroughness and practical point of view.

Sanitation Facilities for Military Posts

By Samuel A. Greeley, M. Am. Soc. C.E. *and* E. Sherman Chase, M. Am. Soc. C.E.
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In the face of the greatest urgency, an effective attempt was made to develop up-to-date sewage treatment facilities for draft army camps. Experiences in the previous war as modified by subsequent advances and by local conditions governed the prompt recommendations of the authors, covering fifty projects. The design principles evolved, and some of the operating experience with the plants as built, form the substance of this paper. It was given first before the Sanitary Engineering Division at the Society's Annual Meeting in January.

Frantic speed characterized the construction of camps, airports, hospitals, and other military establishments to accommodate America's 1940 draft army. To accomplish this construction in the shortest possible time, private firms of architect-engineers were retained by the Quartermaster General to design and supervise the building of these establishments. It is from studies by our firms, covering about fifty defense projects, that the observations here set down have been drawn.

The different types of military posts naturally presented somewhat different problems as regards sanitation facilities. Their salient characteristics may be summarized as follows:

Cantonments for housing troops varied in capacity from a few thousands up to 50,000 or 60,000, with 35,000 more or less as an average.

Armored division posts differed from cantonments in that mechanized artillery units were provided for as well as personnel. Anti-aircraft firing centers were included in this group.

Base hospitals were of various sizes. In some cases they were in or adjacent to communities whose existing sanitation facilities could be utilized.

Air fields, although large in area, were in general relatively small as regards personnel. Consequently their sanitation facilities involved small structures.

Munitions depots, being primarily storage warehouses, had a relatively limited personnel and involved special sanitation requirements.

Some of the establishments were older military posts designated as permanent. Their housing and other facilities were generally of masonry construction, and established sanitation works were functioning. War emergency conditions resulted in the expansion of some of these posts by temporary construction, and the sanitation facilities required enlargement. Such enlargements could be designed with due regard to operating experience with the existing facilities. Most of the establishments, however, were classed as temporary posts, to be used only for the duration. In these cases the bases of design had to be developed rapidly, with little in the way of operating experience for guidance.

GENERAL CONSIDERATIONS AFFECT POLICIES

When our firms were authorized to report on sewage treatment problems at the defense projects, our instructions were to:

1. Advise and report as to the simplest sewage treatment plant at each project suitable and adequate to meet the minimum requirements under local conditions; and
2. Secure modification of plans already prepared where, in the interest of economy, such modification seemed advisable, taking into account, however, the exigencies of the situation.

Furthermore, an official booklet stated:

"In the design of sewage treatment works, simplicity and economy are essential. Only the minimum requirements of the State Board of Health should be met, as the plants are in general expected to be in use for only a limited period. Primary treatment with chlorination will in many cases be adequate. Complicated, unproved, or patented processes should be avoided."

In carrying out these instructions we considered the following general factors:

1. Character and use of the receiving water course or drainage channel.
2. Environment of both treatment plant and camp.
3. Degree of permanence required.
4. Utmost speed in design and construction.
5. Safeguarding the health of both troops and neighboring civilians.
6. Reasonable economy of construction, recognizing that operating costs would not be so important as in more permanent municipal plants.
7. Relation of projects to the National Defense Program, making them of equal interest to all citizens.

Several general considerations influenced our early recommendations regarding design. Economy was a desirable objective, particularly in view of the relatively

Treatment Plant at a Tennessee Camp
Foreground Final Settling Tanks. Background, Trickling Filters and Preliminary Settling Tanks

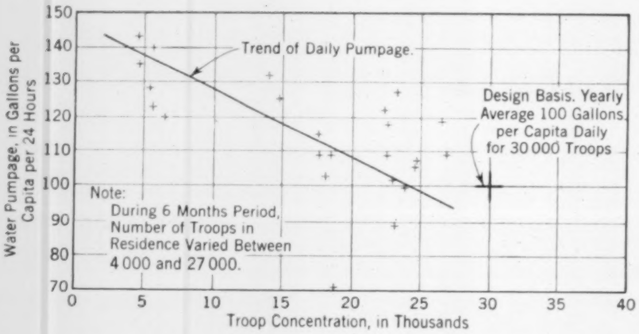


FIG. 1. RELATION BETWEEN TROOP CONCENTRATION AND PER CAPITA WATER PUMPAGE

short period of use anticipated, but economy was secondary to the need for rapid construction. It was planned that the first group of projects started in 1940 should be completed by January 4, 1941, although events proved that this goal was not generally attainable. The 1940 projects were mostly located in the South and West to facilitate troop concentration, and other factors than those affecting sanitation facilities often influenced site selection. Accordingly treatment plant design had to be adapted to site and climatic conditions. One of the most difficult factors was the uncertainty as to the populations to be provided for, but in general those fixed by the military authorities were considered as rigid.

The types of treatment plants adopted (Table I) generally followed conventional and established municipal practice, and the degree of treatment selected in each case was such as to meet local conditions. Some modifications have already been made and others will undoubtedly be made in the future, as and when the results of operation are carefully reported and studied. We have had an opportunity to visit a few of these projects and study the operating data.

QUANTITY OF SEWAGE

Except for the limited data available from cantonment operation during the first World War, there was little upon which to base allowances for flows of sewage to be expected. In the first World War the treatment plants were designed on the basis of an anticipated flow of 55 gal per capita per day. Substantial variations occurred. For the 1940 program it was decided that 70 gal should be ample, but that most of this flow would occur during 16 hours of the day. It was also decided that treatment plants be designed to care for maximum rates of 140 gal, lasting several hours, and that hydraulic allowances be made for flows at rates of 2.5 to 3.0 times the average.

TABLE I. TYPES OF SEWAGE TREATMENT PLANTS AT MILITARY POSTS, 1940

GENERAL TYPES OF TREATMENT	NUMBER OF PLANTS	
	Sludge Digestion	Totals
Connection to city sewer	..	5
Sedimentation only:		15
Imhoff tanks	1	
Separate digestion tanks	14	
Trickling filters, standard:		9
Imhoff tanks	1	
Separate digestion tanks	8	
Trickling filters, high rate:*		14
Imhoff tanks	1	
Separate digestion tanks	13	
Activated sludge:		5
Separate digestion tanks	5	
Others:		
Sand filters, Imhoff tanks	..	1
Sewage ponds, Imhoff tanks	..	2
Enlarging existing trickling filters	..	1
No treatment	..	2
	Grand total	54

* Nine biofilters, five aero-filters.

It was expected that water consumption and sewage flows would approximate each other. In general this seems to have been true but it has also been found that, in some cases at least, the per capita water consumption has varied inversely with troop concentration (Fig. 1). A similar relationship may be presumed to occur as regards sewage flows.

Variations in camp and municipal sewage flows are compared in Fig. 2. From the limited available operating data it appears that a higher unit quantity of sewage and higher ratios of peaks to average flows should be used for the smaller projects.

Sewage flows at some camps have been materially greater than the 70 gal per capita per day anticipated; for example, Camp Forrest, 115 gal; Camp Blanding, 114 gal; Camp Davis, 92 gal; Camp Edwards, 89 gal; and Camp Devens, 86 gal. Experience, however, has shown that continuously flushed urinals materially increase the flow and that the installation of flushometers will greatly reduce it. Hourly variations in several camps are shown in Fig. 3.

SEWAGE CHARACTERISTICS

The probable quality characteristics of the sewage likely to be received at the treatment plants could not be established because of the extremely limited information available; but on the basis of such data as were recorded at the cantonments of the previous World War the composition was predicted (Table II), with an average flow of 70 gal per capita per day. Also given are the average data from ten military posts, on the basis of 15,000 population and 97.5 gal per capita per day.

TABLE II. COMPARISON OF PREDICTED AND ACTUAL RAW SEWAGE CHARACTERISTICS

ITEM	PREDICTED Ppm	PREDICTED Lb per Cap. per Day	AVER. MEASURED Lb per Cap. per Day*
Suspended solids	460	0.27	0.20
Biochemical demand	290	0.17	0.19
Ether-soluble matter	150	0.09	....

* From 10 military posts.

Such operating records as we have scrutinized indicate that the B.O.D. is somewhat higher than the 0.17 used in 1940 for design. However, there is an unusually large variation. Apparently conditions at the camps vary. Thus, when a laundry was built at one camp, its wastes were found to increase the suspended solids by about 21% and the B.O.D. by about 25%. Also, differences in operating efficiency, particularly as regards the cleaning of grease traps, may account for variations. At present we understand that the engineers of the War Department are inclined toward a B.O.D. of 0.20 lb and have not yet changed the units for suspended solids and ether-soluble matter.

These data represent information of limited scope and accuracy and should not be accepted as final. However, they appear to indicate that the per capita contributions of oxygen demand have been higher, and those of suspended solids lower, than was anticipated.

Although relatively large quantities of greasy scum were expected, the installation of special preliminary grease-removal devices at the treatment plants was not advocated. Grease traps were provided on mess hall drains, but in one instance at least, when these traps were cleaned the contents were dumped into sewer manholes. Evidently more consideration should be given to the way

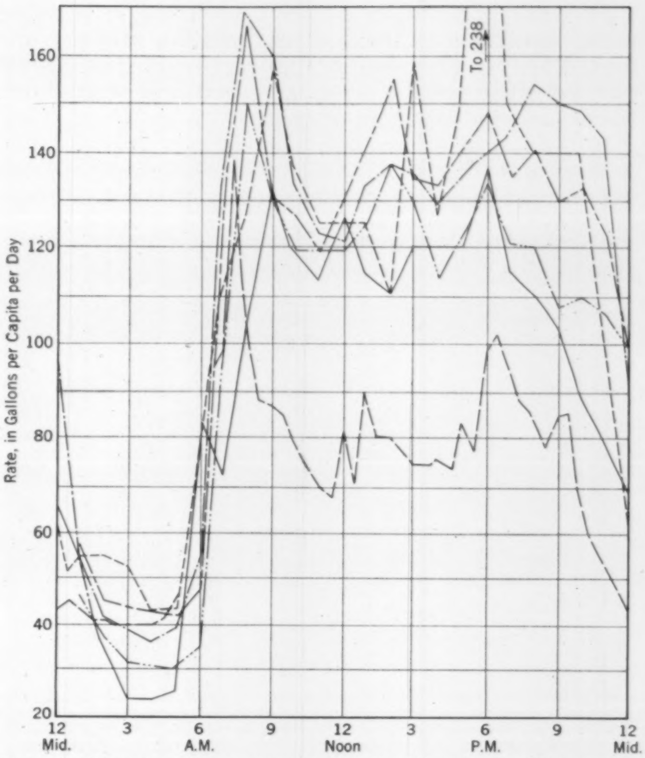


Fig. 3. Hourly Variations in Sewage Flow at a Number of Army Camps, 1941

grease traps are installed and maintained. To date there seems to be no more reason than formerly to provide grease-removal apparatus ahead of sedimentation tanks.

The original recommendation to use hand-cleaned bar racks seems in general to be sound for small and medium sized plants. At the larger camps mechanical screens can be used to advantage, particularly if of the type where ground screenings are returned to the sewage, thus obviating the handling and disposal of substantial quantities of objectionable screenings.

Apparently if bar screens are hand cleaned, they should have a somewhat greater spacing than for domestic sewage, perhaps a minimum of $1^1/_4$ in. At one camp, where they had a clear spacing of 1 in., it was necessary to clean them every hour, and in this interval a differential head of almost 1 ft was built up, thus causing pulsations in the flow to the sedimentation tanks. At another camp a clear spacing of $1^1/_2$ in. required cleaning once every three hours and a maximum difference in elevation of about $2^1/_2$ in. If the wider spacing is practicable, hand-cleaned screens seem to be satisfactory except in the larger projects.

NEED FOR FLOW MEASUREMENTS AND OPERATING DATA

Measurement of sewage flows was and is strongly advocated. Various types of measuring devices have been employed, but in general, weirs, Parshall flumes, or Palmer-Bowlus rectangular flumes are suggested. Venturi meters appear better adapted for effluents. The desirability of means for making continuous records of flow has been demonstrated and these have been generally provided.

Such operating experience as we have been able to review indicates that grit chambers are not generally required. The 1940 bases of design stated that grit chambers were to be omitted except in special circumstances, and this seems to be the prevailing opinion.

For sedimentation, the use of mechanically cleaned settling tanks or Imhoff tanks received approval. In the case of mechanically cleaned tanks, the architect-engineers were advised to decide whether local conditions indicated that tanks circular or rectangular in plan were preferable, and to select the type best adapted.

The 1940 bases of design provided a displacement period of 3.0 hours in preliminary sedimentation tanks, based on an average flow of 70 gal per capita per day for standard trickling filter plants. A general measure of the necessary size for the preliminary sedimentation tanks is the effect on the reduction of B.O.D. Only limited operating records have come to our attention. It was suggested in the 1940 data that with fresh sewage and a relatively liberal displacement period, the reduction of B.O.D. by sedimentation might be 50%. Operating experience indicates, however, that such removals have not been obtained at all plants, removals of 40% being more nearly representative.

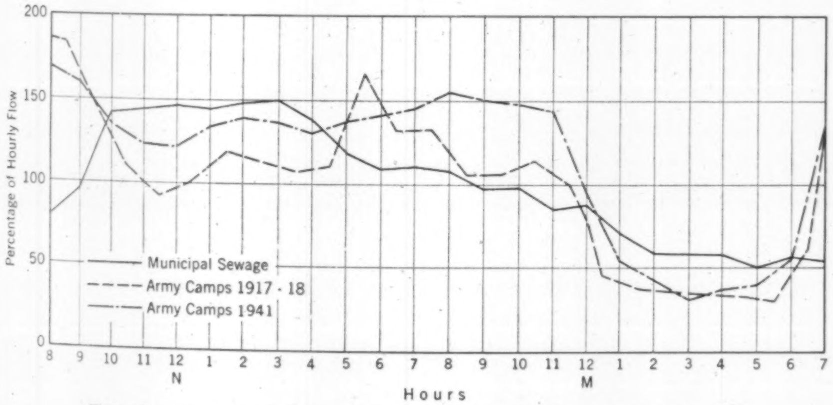


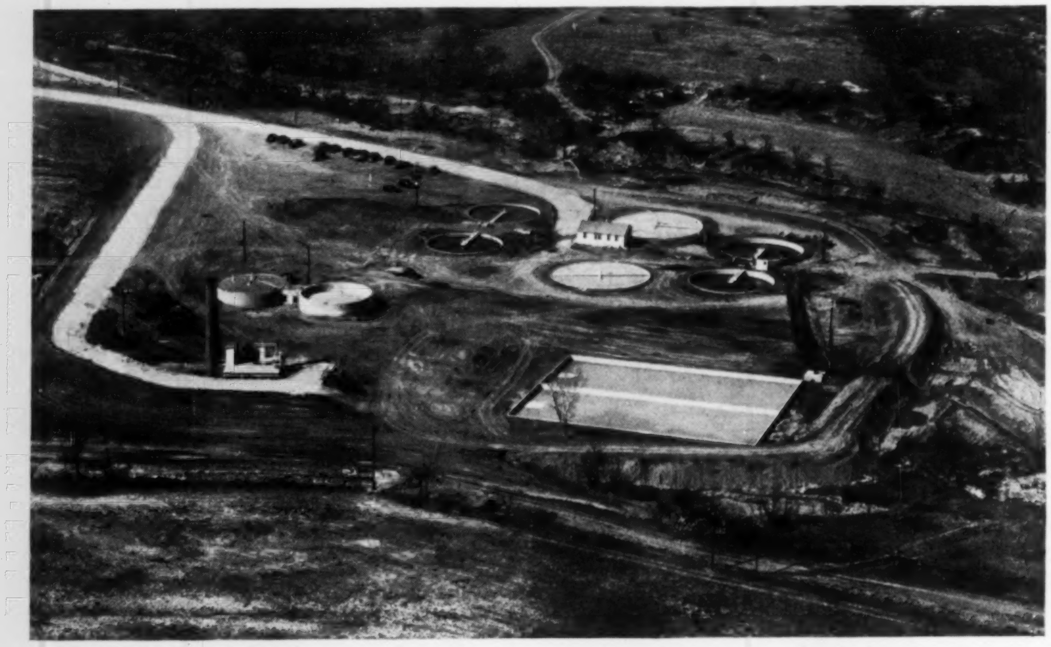
Fig. 2. Comparison of Hourly Variations in Sewage Flow

The decreased removal efficiency in turn has had a bearing on the loadings of secondary treatment features. For example, it was expected that the oxygen-demand loadings on standard trickling filters caring for 4,000 to 5,000 persons per acre-ft would be satisfactory, based on 0.17 lb of demand per capita and 50% removal by sedimentation. On the basis of 0.20 lb of demand and 40% removal, the load in terms of oxygen demand would be increased by about 40%. The increase in loading would occur with other types of secondary treatment. No evidence, however, has come to our attention that such increases in actual, over anticipated, loadings have seriously affected operating results. The loadings recommended took into account differences in climatic conditions, and somewhat higher loadings were approved for secondary treatment features in southern camps.

Our recommended design data and plant loadings corresponded fairly well with accepted practice for municipal plants. As regards some of the newer modifications of older forms of treatment plants, such as high-rate trickling filters, it was recognized that the degree of treatment might well be less than with standard trickling filters; but the saving in construction cost and favorable experience with the newer type of filter appeared to justify its use where conditions warranted.

Untried treatment processes, or those with which experience was limited, were not approved. Activated sludge plants were not looked upon favorably in general, but a few exceptions were allowed where special conditions made this type of treatment justifiable. Chemical precipitation was not approved, largely on account of the operating cost for chemicals and their possible shortage under war conditions. Events have justified this stand.

In the case of sludge digestion, either in Imhoff tanks or in separate digestion tanks, much the same allowances were recommended as are considered good standard practice. Recognition was given to differences in climate and to the possibility that some of the separate digestion tanks would be unheated. In a few instances old Doten tanks were adapted for digestion of sludge. It is reported that in some cases at least, these converted tanks have not proved very satisfactory.



COMPLETE SEWAGE TREATMENT FOR A SOUTHERN CAMP
Facilities Include Two-Stage Biofilters, Clarifiers, Distributors, and Other Features

OPERATION HAS PROVED INSTRUCTIVE

Experience to date indicates clearly the need for adequate records of operation at the existing treatment plants, and for correlating these records with the populations and conditions peculiar to each post. This need was anticipated, and our early report listed the equipment necessary for securing the essential analytical data. Recognition was made, however, of the different types of treatment and variation in size of plants by recommending less extensive tests for small plants and plants affording only limited treatment.

Laboratories have been provided at most plants and data are being recorded. Because of delays in organizing the work and in tabulating and studying the data obtained, it has been difficult to secure complete and authentic information. Summarized analytical results of operation for three treatment plants are given in Table III.

TABLE III. ANALYTICAL RESULTS FROM THREE SEWAGE TREATMENT PLANTS AT MILITARY POSTS

	SUSPENDED SOLIDS, PPM			5-DAY B.O.D., PPM		
PLANT	Raw Sewage	Prim. Tk. Eff.	Final Tk. Eff.	Raw Sewage	Prim. Tk. Eff.	Final Tk. Eff.
Activated sludge*.....	195	136	21	204	155	23
Imhoff, high-rate trickling filter†.....	115	52	34	190	107	79
Imhoff, high-rate‡ trickling filter......	240	66	25	350	190	40

* Average for five months.
† Average of seven 24-hour tests in seven different months (biofilter).
‡ One-day composites, 10 a.m. to 3 p.m.; recirculation.

These data are too meager and other information relative to conditions affecting operation are too limited to permit drawing definite conclusions. Table III is presented to show what is being accomplished at the treatment plants at some posts.

Analyses of hourly samples at one camp, as given in Table IV, show that variations in the strength of its sewage roughly parallel variations in rates of flow. They are not greatly dissimilar from the variations that occur in the strength of municipal sewage.

Too much emphasis cannot be placed on the need for competent and faithful operation of sewage treatment plants at military posts. It is also highly important that laboratory findings be used to guide economical operation and to provide reliable data from which future plants or enlargements to existing plants may be designed. The paucity of data from World War camps constituted a serious handicap to those entrusted with the design of the sanitation facilities in the present emergency.

TABLE IV. HOURLY VARIATIONS IN STRENGTH OF CAMP SEWAGE
Average of Two 24-Hour Test Runs

TIME	SUS. SOLIDS, PPM	5-DAY B.O.D.	TIME	SUS. SOLIDS, PPM	5-DAY B.O.D.
1 a.m.	38	88	1 p.m.	85	150
2 a.m.	48	64	2 p.m.	180	328
3 a.m.	26	30	3 p.m.	183	308
4 a.m.	13	32	4 p.m.	176	205
5 a.m.	27	37	5 p.m.	124	140
6 a.m.	78	97	6 p.m.	90	158
7 a.m.	150	183	7 p.m.	131	213
8 a.m.	143	228	8 p.m.	187	330
9 a.m.	235	285	9 p.m.	191	275
10 a.m.	155	238	10 p.m.	111	205
11 a.m.	158	203	11 p.m.	74	160
12 noon	171	203	12 midnight	50	135

Recognition of this fact has led to the placing of trained civilian personnel in charge of the operation of utilities, including sewage treatment plants, at Army posts. The broad outlines of this policy were well described by Lt. Col. G. F. Lewis, Chief of the Repairs and Utilities Branch of the Construction Division, in a paper presented before the American Public Works Association at New Orleans on October 28, 1941.

We are in hearty agreement with this policy and trust that the experience and data secured by civilian operators of sewage plants at these military posts will be made available to the Society in detail in the not too distant future. We wish to express our appreciation of the data and cooperation received from many civil and military authorities.

The Army Specialist Corps

New War Service, Open to Engineers, to Assume Some Tasks of Regular Military Officers

By William O. Hotchkiss, M. Am. Soc. C.E.

Deputy Director, The Army Specialist Corps, Washington, D.C.

Again "Civil Engineering" is privileged to present an article in the series dealing with various government services attuned to the war effort. This one has to do with a brand new activity—specially related to engineering. The Army Specialist Corps is a uniformed commissioned adjunct of the Army, having semi-military characteristics. It will do engineering and other administrative work designed to free regular officers for military duties. From intimate knowledge, Dr. Hotchkiss speaks with authority on the purposes, functions, and procedures designed to make the Corps an effective instrument for war.

That the Army Specialist Corps was established is due to the initiative of Gen. George C. Marshall, Chief of Staff. It is based upon the fact that the conduct of war requires the exercise of a wide diversity of functions. The highest of these functions relate to strategy and tactics in handling combat troops. This requires officers of professional military quality who have devoted their lives to the study of military affairs and have been trained by the government for these purposes.

There are multitudinous other functions which are essential adjuncts to the professional military functions. These relate to the procurement, testing, transportation, warehousing, and shipping of materials, and their provision in adequate quantities and of proper quality at the place and time needed by the combat troops. They include the many technical and scientific services so necessary for the conduct of a modern war. Functions of this sort have many close analogies in civil occupations and many civilians are possessed of a wide experience and great skill, gained in their private affairs without expense to the government, that can be brought into the service of the Army to carry out those military functions that do not require professional military skill and experience.

QUALIFIED BY CIVILIAN EXPERIENCE

One purpose of the Army Specialist Corps is to provide for the various services of the Army officers who are possessed of the business and technical experience and qualifications, acquired in their civilian occupations, to relieve for duty in command of troops the officers of the Army who have professional military training and experience. Stated briefly, one of the principal functions of the Corps may be said to be to secure properly qualified men from civil occupations to perform military duties that otherwise would require the services of professional military officers of the Army of the United States.

The functions of the officers appointed by the Army Specialist Corps, therefore, do not require the military training that is requisite for the handling of troops in combat, and the development and carrying out of the strategy and tactics of operations that are necessary for the successful winning of the war. The Corps officers will not be combat officers. They will not be issued arms nor will they exercise military command of troops except in cases where armed military personnel may be assigned to aid them in the performance of non-combatant duties of which these officers are in charge.

The Army of the United States has recently been reorganized into three major parts:

1. The Army Ground Forces
2. The Army Air Forces
3. The Services of Supply

Army Specialist Corps officers will be used in greatest numbers in connection with the Services of Supply. They will be required in many of its staff divisions, supply services, and administrative services as indicated in procurement objectives already received from the following list and from others not named:

Transportation Division
Corps of Engineers
Signal Corps
Quartermaster Corps
Chemical Warfare Service
Ordnance Department
Post Exchange Services
Statistical Service
Special Services
General Depots Division
Provost Marshal General
Judge Advocate General
Public Relations
Military Intelligence

In addition to serving the organizations in the Services of Supply, Army Specialist Corps officers will be used in the Ground Forces and in the Air Forces. These men will serve as special service officers, supply officers, engineer officers, research officers, statisticians, quartermaster personnel, classification personnel, ordnance personnel, public relations officers, communication officers, post exchange personnel, accountants, and in many other fields. Many technical positions in motorized and air units will be filled by Army Specialist Corps appointees. The foregoing serve as illustrations of the wide variety of services for which the Corps officers will be requisitioned.

The Army Specialist Corps will maintain no operating body of troops of its own. Its officers are appointed only upon requisition from the various arms and services of the Army and other branches of the War Department or of other emergency organizations to which the War Department assigns Army personnel. Upon appointment they are immediately assigned to duty with the requisitioning agency and are thereafter under its orders.

SELECTED FROM ALL BRANCHES OF CIVILIAN LIFE

From the foregoing description of the purposes and functions of the officers appointed in the Army Specialist Corps it is obvious that the kind of men who are needed for this service are men of officer quality of the highest kind. They must be men of unquestioned character, of good bearing, of satisfactory education, of good teamwork capacity, and they must be possessed of special skills and experience of a wide variety.

The securing of the men to be commissioned in the Army Specialist Corps will in the first instance be from the applications filed in the Adjutant General's Office. In case these do not supply a sufficient number of men with the requisite qualifications, the next source of supply will be from the files of the Civil Service Commission, which include the National Roster of Scientific and Specialized Personnel. If these lists do not furnish the necessary number, the Army Specialist Corps, in cooperation with the Civil Service Commission, will appeal to business organizations, to colleges, and to various other organizations through which lists of men of the required type may be obtained.

OTHER PRELIMINARIES AND EXAMINATIONS BEFORE ACCEPTANCE INTO CORPS

Based upon the requisitions made upon the Army Specialist Corps by the various Arms and Services, men of the required qualifications will be selected from these various sources. If they have not already done so, the individuals who seem to fit the requirements for the work, as determined jointly by the Army Specialist Corps and the requisitioning agency, will be asked to fill out a Personnel Placement Questionnaire, Form 0850 of the Adjutant General's Office, which is a very full and complete questionnaire calling for information about the individual candidate. These forms may be obtained from Corps Area headquarters, from the Adjutant General's Office, or from the Army Specialist Corps in Washington. After an examination of the information on these questionnaires, the selection of the men for commissioning is made by the Army Specialist Corps with the approval of the requisitioning agency. Final selection is made after a personal interview.

These candidates are then given the regular final-type medical examination required of all officers in the Army. The examining surgeon must certify as to whether the candidate is capable of "arduous, moderate, or light" physical exertion. If the physical capacity of the candidate is up to the requirements of the position for which he is to be appointed, he may be accepted even though he is far below the physical requirements for the Army of the United States. An eligible man of any age may be appointed if he is able to perform the work which is needed. The emphasis is upon the brains and ability to perform the particular work, rather than upon age or physical condition.

CORPS NOT COMPETITIVE WITH OTHER SERVICES

Officers of the Specialist Corps will be required to fill many kinds of positions. Many will be used for office duties. The physical health and age requisite for the performance of the particular job is all that will be required of them. Others will be needed for service abroad with combat troops. For such officers the age and physical requirements will necessarily be almost as strict as for officers in command of troops.

With regard to draft status, the Army Specialist Corps does not compete with the Selective Service. Men who are of the age and physical condition that puts them in Class 1A, suitable for immediate induction, may not be appointed in the Army Specialist Corps. Men under 30 years of age may not be commissioned in the Army Specialist Corps unless they are in Class 4F, permanently physically disqualified for general military service, except in case of very special qualifications required for an urgent need, and then only with the approval of the Secretary of War in each case. No one in the conscientious objector class may be appointed. Those in other draft classifications may be appointed as officers in the Corps, but if reclassified and put in 1A at a later date, they may still be called under the Selective Service Act.

Appointment in the Army Specialist Corps does not alter the appointee's liability for active military service under the Selective Service Act. The Corps also does not compete with the Selective Service in that it may not appoint any one who for occupational reasons is deferred from induction. Necessary men in industry are not taken into the Corps any more than they are taken into the Army of the United States.

ROUTINE PROVIDED FOR APPOINTMENT

After appointees have thus been screened out and selected, their complete file is sent to the War Department Personnel Board for its approval. This Board passes upon all officers appointed to the Army of the United States and the Army Specialist Corps. After their approval, those who are to be appointed to the rank of Major and above must be nominated by the President and confirmed by the Senate before their commissions can be issued. Men in ranks below that of Major may be appointed without nomination by the President and confirmation by the Senate.

After these procedures are concluded, the Director General of the Army Specialist Corps forwards the papers to the Adjutant General, who issues the commissions, oath of office, and orders to the candidate. Thereupon the candidate reports for duty when and as ordered. These orders assign the Corps officers for duty to the arms or services which requisitioned their services. This routine is substantially parallel to that required for the appointment of an officer in the United States Army.

OUTSTANDING PERSONNEL AND SERVICE IS ASSURED

When the supply of men having the special qualifications desired is not sufficient, the Army Specialist Corps is authorized to provide training for qualified trainees. In this group will be many officers having scientific and engineering training, who may require special courses to fit them for special functions. The supply of such men is quite inadequate, and many will have to be trained. Electrical engineers and physicists particularly are available in such small numbers that it will be necessary to recruit many officers who have had the first year of college physics, and mathematics through the calculus, to train for the many special needs of the Army.

Many electrical engineers who have graduated in the last ten or fifteen years have gone into other fields of activity in which their knowledge has faded through nonuse. These can be commissioned and given refresher courses first and then the advanced courses required for the special duties they will perform. In this group will be included many who have had to leave college before completing their full engineering course.

I have given you a brief picture of the purposes, operation and function of the Army Specialist Corps. From this picture it is obvious that this Corps will furnish an opportunity for a high type of patriotic service to many loyal citizens who have heretofore been barred. By reason of age or physical imperfections many who want to serve have been ineligible for service in the Army of the United States. Many of these will find in the Army Specialist Corps the very welcome opportunity to serve which their patriotism is seeking.

It will be a corps of men outstanding in character and ability. Every man in it will be serving because of an intense patriotic desire to do his bit for his country in its time of peril. The Corps will thus be an effective aid in making use, to the fullest possible extent, of the patriotic manpower of the Nation in its hour of need.

Saving Steel by Substituting Concrete

By Hardy Cross, M. Am. Soc. C.E.
Professor of Civil Engineering, Yale University, New Haven, Conn.

STEEL is today a critical material, to be used sparingly or eliminated entirely. This paper is confined to the immediate need of saving structural steel, with special reference to the substitution of concrete. It is intended to be suggestive, not definitive. There is a growing literature in this field and for that reason references have been avoided. It is, however, important to refer to the paper by R. L. Bertin, M. Am. Soc. C.E., in the February "Journal of the American Concrete Institute" and to later discussion of it in that Journal, as for example in the April issue. Originally, Mr. Cross's paper was on the program of the Structural Division at the Society's Roanoke meeting in April 1942.

STRUCTURES now being built may be intended to be permanent or temporary. Probably many structures designed now for war service will be in use longer than planned; and their use may be changed. It is well to remember this though the consideration is not now controlling.

In any event, for the present the use of structural steel should be avoided—substitutes should be used wherever possible. The problem is not one of economy in the ordinary sense, but of saving steel. Timber, plain concrete, brick, or clay pipe should be used if possible, otherwise combinations of familiar type—one material for tension, another for compression. Of such combinations reinforced concrete is the most familiar.

It seems especially important now to save plates. Hence the choice of reinforced concrete for bins, bunkers, and tanks, where straps at high stresses replace plates.

As a guess I believe that, of the total tonnage that would in normal times be estimated for construction to be done during 1942, about 40% can be eliminated for the emergency. Of this 40%, about 25% can be eliminated by substitution of timber, of plain concrete and other materials, and of reinforced concrete, the saving from these three sources being approximately equal. Of the remaining 15%, about one-half may be effected by further rationing at the source—simply by elimination of the work—and the remainder by revision of codes and by special expedients in design beyond those already taken to make substitution possible. This estimate is crude and probably everyone will get different figures—but it is important that some estimate be made. Ingenuity in design is thought to be important more because it makes substitution possible than because of further saving of steel after the substitute is chosen.

Plain concrete and plain masonry are replacing reinforced concrete and iron for culverts. Note that the amount of tensile steel needed for flexure is less if there is also direct compression in the member; hence the availability of arches and of dome construction to save reinforcing steel. Plain concrete is the obvious solution for foundations and slabs on earth. Prestressed reinforced concrete is now indicated as desirable for tanks to replace steel plates.

For mill buildings and one-story sheds—the principal field of industrial construction—reinforced concrete should be considered. This may include rather long spans of rigid frame and also the usual moderate spans of saw-tooth construction. Pre-casting with welded splices has been used satisfactorily and should be considered on large jobs.

In a letter to the writer, A. J. Boase, M. Am. Soc. C.E., says:

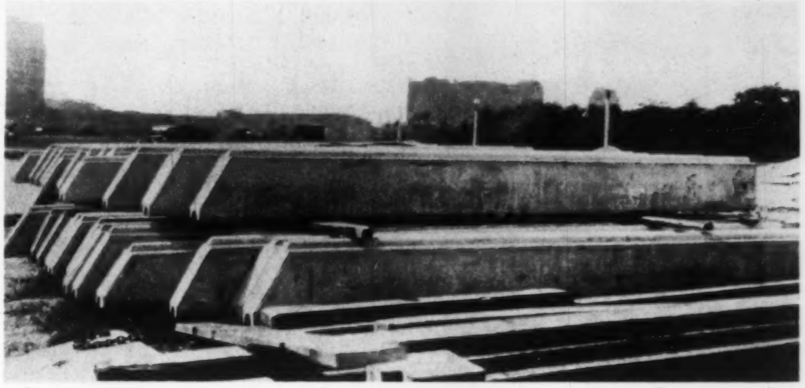
"Other places where concrete is being substituted for steel are concrete ramps (to replace elevators), coaling pockets, pipe, concrete load-bearing piles, and concrete sheet piling. Many inquiries are being received now (starting very recently) on the substitution of concrete poles on transmission lines and trolley lines. I expect we will see a great deal of this. From inquiries we have received from various sources I judge that stacks will come in for considerable play too."

Various expedients are available for long-span construction. Most of the concrete roofs in the near future will be limited to 60–80 ft. But spans up to 150 ft or over are quite feasible. Usually these will be rigid frames and every effort should be made to lighten the construction toward the center. Hollow sections are possible but not often advisable. Some weight can be saved by using I-sections. Concrete trusses are not much lighter than I-sections and are rather messy to build. Vierendeel girders have been used but it should be noted that the open-web girder has very little continuity; it acts in any case nearly as a simple span. The semi-Vierendeel—that is, Vierendeel form toward the center where the shear is low, and solid web toward the ends—projecting beyond the roof lines at the eaves for rigid-frame construction, offers real possibilities.

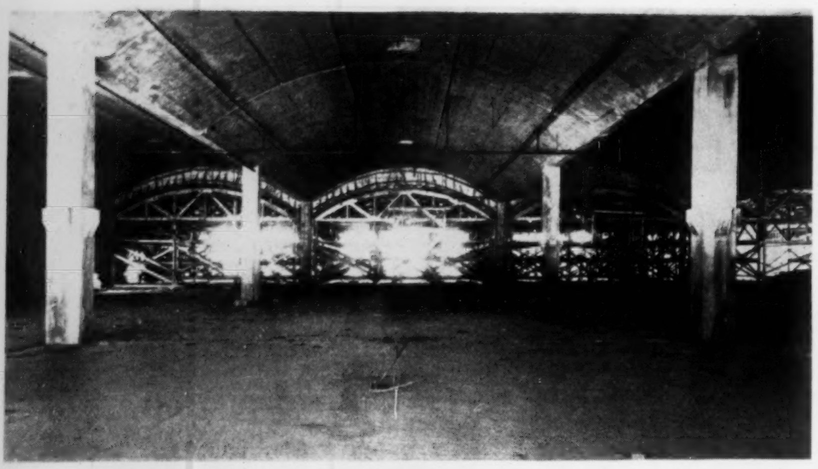
WIDER USE OF CONCRETE

Use of rigid frames and of the more modern types of design is recommended not because they are inherently economical but because they make possible the substitution of concrete for steel. Pre-cast construction and long-span construction can often be effected more easily by the use of continuity.

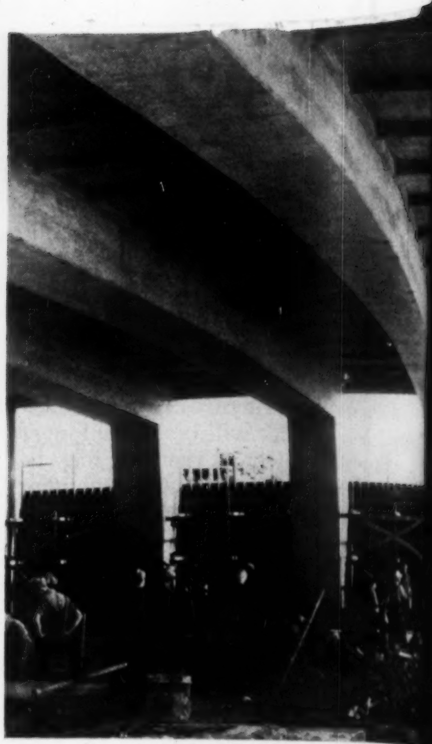
Concrete offers special opportunities for designing in three dimensions—such as domes and shells—by using walls as beams and by the general use of a single member to resist forces acting in different planes. Economies



Reinforced Concrete Sheet Piles for Chicago Waterfront

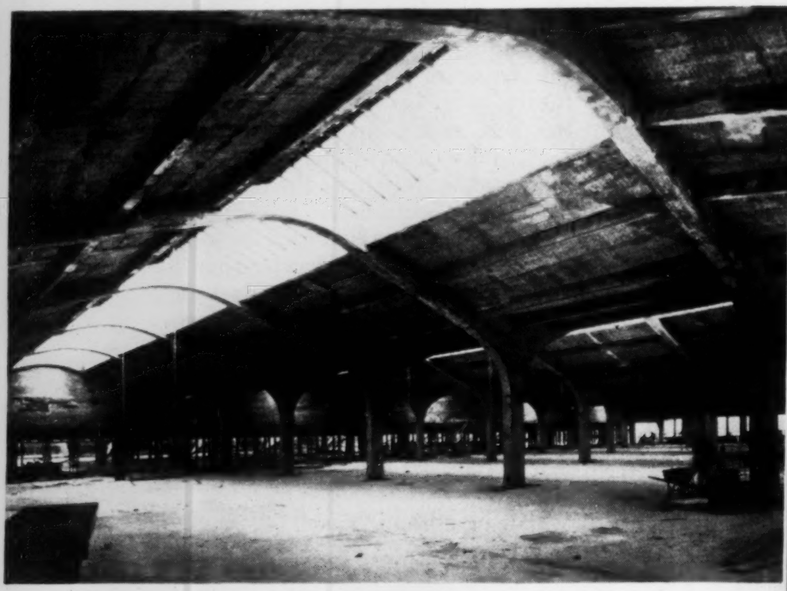


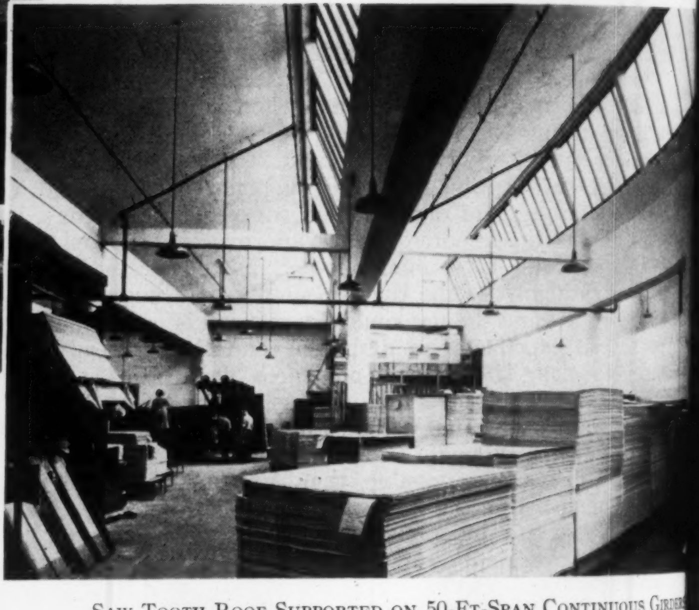
Barrel Shell Roof in an Industrial Plant
Bays, 40 Ft Wide; Columns, 50 Ft on Centers;
Shell Averages $3^1/_2$ In.



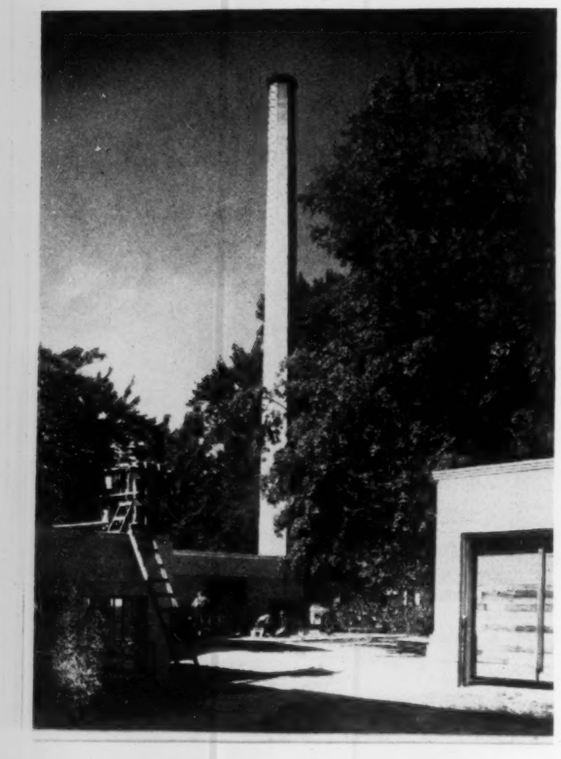
Hangar Building Has 14,000 Sq Ft of Clear Floor Space
Rigid-Frame Roof Members Are Hollow and Span Is 150 Ft

Multiple-Span Rigid-Frame Roof Covers Amphitheater in Union Stock Yards, Chicago

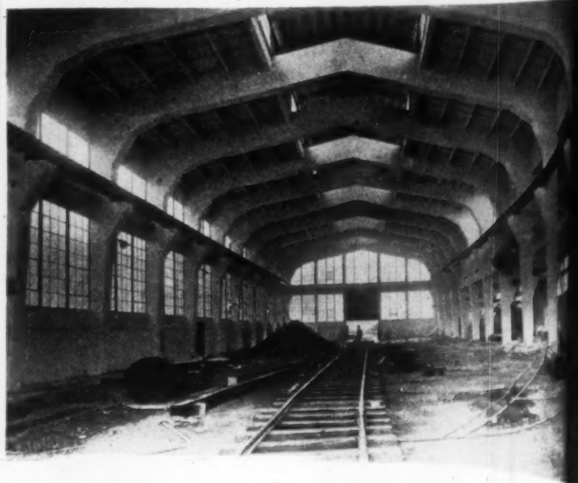




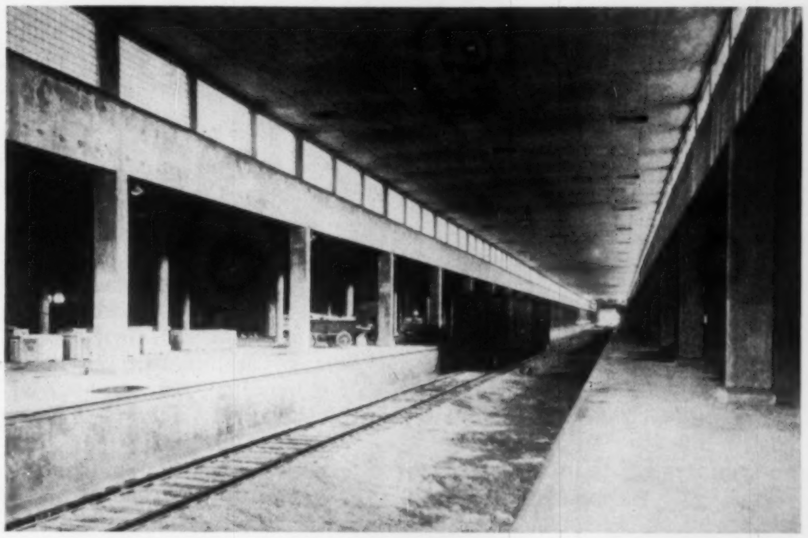
Saw-Tooth Roof Supported on 50-Ft-Span Continuous Girders
Note Horizontal Concrete Brace Between Girders



Stack 75 Ft High for School Heating Plant in Michigan—Steel is Often Used for This Purpose



Continuous Concrete Frames of 70-Ft Span for Smelting Plant from this source are more in total quantities than in steel alone.



All-Concrete Warehouse for the Army
This Building Is 1,400 by 500 Ft. See Fig. 1 for Section

Existing codes and specifications have become so complex as to discourage substitution of reinforced concrete by those not accustomed to designing it. Code and specification revision is usually a slow process; if it could be done quickly and in the direction of simplicity, revision would be useful.

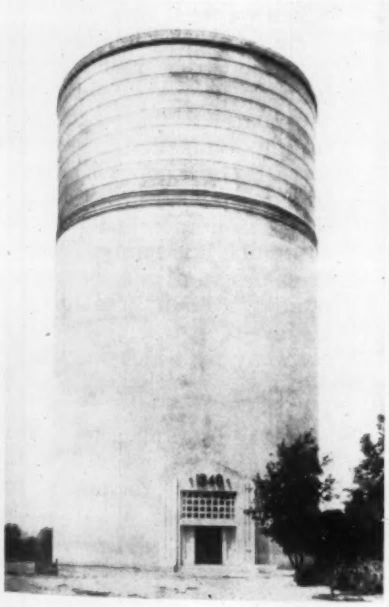
In specifications for design, three factors are interrelated—the loads specified, the allowable stresses and methods of computing them, and the rules for detailing. In reinforced concrete the dead load is relatively great and economy from reducing the live load is not usually pronounced. Rules for detailing, while more or less arbitrary, are closely dependent on experience with working stresses; large increases in working stresses may lead to secondary failure unless the rules for detailing are revised.

Compressive stress in flexure with modern concrete and existing codes is not usually important, and bond is not often important. With increased steel stresses the concrete stresses are still not controlling at failure, but bond stresses may become important. High steel stress tends to break down the bond and this in time threatens the web near supports.

In reference to stresses in reinforcement, T. D. Mylrea, M. Am. Soc. C.E., who has given much thought to such matters, writes me:

"I would say that on the condition that the working stress in flexure does not exceed 50% of the yield point of the steel, a working stress of 30,000 lb per sq in. is not too great, providing secondary failure due to bond or anchorage is guarded against.

"In my own tests I found that when high steel stresses were used, failures from secondary causes had to be guarded against. Similarly in simple beams, where the anchorage and shear were properly cared for, all cracks were fine at a computed steel stress of 30,000 lb per sq in. In continuous beams there is real cause for concern at points of negative moment. Here anchorage is of special importance."



Elevated Concrete Tank, of Million-Gallon Capacity, for an Eastern Training Center

I believe that code revision for war purposes should aim chiefly to encourage substitution, especially by simplification. Increase in steel stress is less important.

Increased depth may save steel, but this depends on the relative amount of load from the weight of the member itself; if the moment results chiefly from the weight of the member, there will be no saving. In order to make long-span substitution possible, it may be advisable to use thin slabs and thus cut dead weight. Deflection of slabs is relatively less important in war construction. In columns, a minimum of steel should be used. In haunched beams of rigid frames, a small center depth and a large end depth should be used to save steel.

Under present codes, flat slab decks are estimated to give minimum steel, the advantage increasing with the live load.

When over-all economies are considered, use of reinforced concrete will save steel, will almost certainly save time if structural deliveries are slow, and will not use more man power than will structural steel. The substitution here recommended gives opportunities for the ingenuity that has always characterized the work of American designers and builders. I am especially impressed with the following from Mr. Boase:

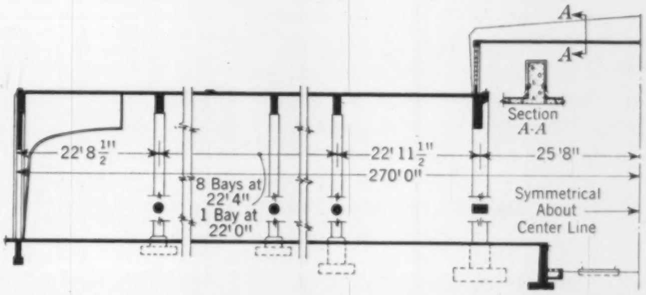


Fig. 1. Section Through 17-Acre All-Concrete Army Warehouse

"In the cases that we have followed, the contractors have proved themselves unusually versatile in switching from steel to reinforced concrete. Actually, I believe the contractors meet the situation much better than the engineers do and there has been a surprisingly small amount of difficulty in the field. This has been so marked that it makes me ask the question, 'What do we mean by being practical?' As I understand that phrase, actually what we have meant in the past is that we were trying to turn out designs that would meet the contractor's everyday procedure without any particular change in his set-up. Today I think it is a fair statement to say that some of this is being discarded, and it seems to me the contractors are able to change their procedures much more readily than are the engineers."

Public Works in a Post-War Program

Focus Should Be Placed on National Development as the Chief Objective

By Frank W. Herring, M. Am. Soc. C.E.
Assistant Director, National Resources Planning Board, Washington, D.C.

The economic aftermath of the last war still haunts America. If repetition is to be avoided, some means must be devised for transfer, at the proper time, of the national effort from war activities into the channels of peace. Public works is the most promising solution. From his diagnosis of the principles, Mr. Herring concludes that a continuing plan for national development is the most desirable objective of such a program, that it should lend itself to maximum employment of labor and utmost flexibility of operation. This stimulating paper is condensed from an address before the session on "Preparedness for Post-War Conditions" at the Annual Meeting of the Society, which was held in New York in January.

Planning for a post-war public works program is really planning for one aspect of the post-war world. What kind of world that will be, of course, we cannot now know. We do know, however, that the world of today is vastly different from the one we knew no more than two or three years ago. As recently as 1939, it was being said that continued mass unemployment was the central economic problem of the country, but today the problem is one of finding enough men, materials, and hours to enable us to double and redouble our national output. When victory comes, what problems shall we be facing?

A complex problem of this sort cannot be solved in a few weeks. The solution requires long, painstaking study and hard work. Furthermore, many of the most important determinants cannot now be forecast.

But a few aspects of that problem, in the light of today's information, can be roughly outlined. For example, when victory comes we shall have been exerting our maximum of productive effort. The value of this production will probably be well over 100 billion dollars annually, the major portion being for the war effort. Will cessation of hostilities be followed by a drop in national income? Will the steel mills, the aluminum plants, the engine factories, and the transportation system go on part-time schedules? Will the millions of men who have been giving their utmost in the war effort be no longer needed? Shall we experience a faltering economy and a society which is out of adjustment with its potentialities?

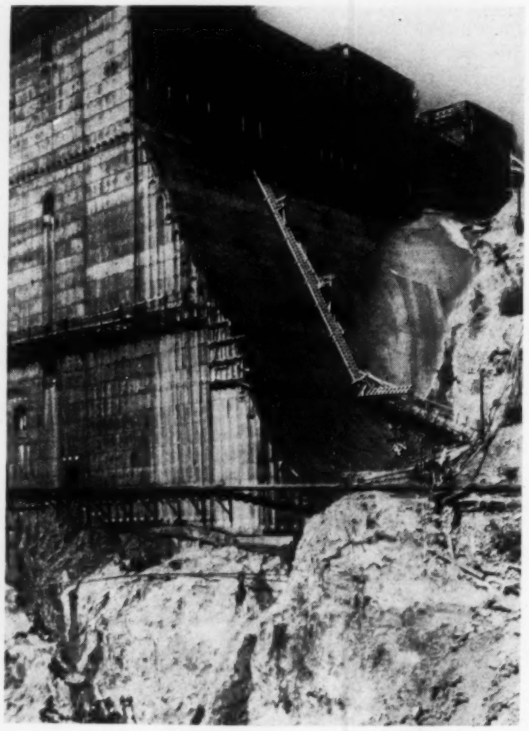
A DEFINITE OBJECTIVE SOUGHT

Such a nation would not be victorious, regardless of what the military outcome had been. It would be a defeated and unhappy land. We must set a goal for ourselves. We must make sure that our man power and our productive facilities will be fully employed to bring about the high level of income of which we now know we are capable. We must plan to balance our national production-consumption budget at a high level with full employment, not at a low level with mass unemployment.

A broad program of building public works must be an important part of our plan. Through public works, underdeveloped areas of our country are stimulated toward greater productivity, commerce and industry are facilitated, life and property are made more secure in the city and on the farm, metropolitan civilization is made possible. Through the construction process employment is created, industrial production is brought about, and the circulation of the income stream is aided. Our public works program will fill a vital role in our total plan to keep our economy functioning at a high level, to direct toward the uses of a world at peace strengths and energies at least equivalent to those now so necessarily directed toward national defense.

The task of making our nation the land we intend it to be is an enormous one. Our cities are badly down at the heel and need rebuilding; our transportation system requires modernization; much of our population needs to be rehoused; our polluted streams need cleaning up; our fertile lands must be saved from destruction. These are but a few of the things we need to do, of the public works projects for which we must plan.

But obviously a public works program can be but one element in the total plan, one step toward the goal. It must be flanked by programs designed to call forth the maximum of effort by private industry, programs of social insurance and programs of public assistance. And all these programs must be properly related so that equilibrium is achieved in the high-income economy for which we plan.



Dams Have Had a Large Place in Public Works Progress

Looking Up at Large Block, Shasta Dam, California

SEVERAL GOALS

In the total plan, then, what role is to be assigned to the public works program in the post-war period? What shall we expect it to accomplish?

There are at least three objectives that might be set: (1) to further the physical development of the United States so as to bring it into closer accord with our national aspirations; (2) to stimulate and support the nation's economy through the orders for materials and the wage payments that are occasioned by the construction process; (3) to provide opportunities for employment for those who would otherwise not be employed. These objectives are complementary, not exclusive. A program of public construction can be made to achieve all three.

If national development is chosen as the principal objective, the other two goals are almost automatically won. To illustrate, the needs of public construction for materials make heavy demands upon the products of industry. Steel, copper, timber, petroleum products, cement, brick, tile, glass, machinery—all these and many other industrial products are called for in huge quantities by a program of considerable magnitude. In fact, the industrial processes upon which such a program depends ordinarily account for a larger share of the value of the final product than does the construction process itself.

Overall View of Shasta Project, Looking Downstream
One of Largest Current Jobs Being Done by the Government

Moreover, the geographic distribution of the activity generated by such a program is not adequately disclosed by the locations of the projects themselves. The manufacture of the materials required ordinarily takes place at many other, perhaps distant, points. A bridge constructed in Texas may mean employment in the steel mills in Gary; a water line built in Virginia may secure the job of a foundryman in Birmingham.

MAXIMUM NATIONAL DEVELOPMENT IS AIM

However, it does not necessarily follow that maximum national development will automatically be achieved if the primary aim of the program is business stimulation or employment creation. A program could be planned that would require the employment of many people but would not necessarily contribute greatly toward the development of the nation, or even provide any powerful stimulus to private industry. Also one might be planned to provide a maximum of industrial stimulation and still fall short of bringing about the best sort of national development.

A program focused upon national development will, in proportion to its magnitude, tend to keep at their jobs many of industry's workers, particularly those engaged in the production of materials used in construction. The employment effectiveness of such a program, therefore, is not to be measured by the number of people given new jobs on actual construction, but must take into account the industrial workers who retain their jobs because of the program's need for materials. In fact the objective of such a program, in employment terms, might be thought of as the prevention of unemployment rather than the creation of additional employment.

On the other hand, a program focused upon employment creation will, again in proportion to its magnitude, tend to make new jobs on construction operations for men formerly engaged elsewhere. In order to create as much new employment as possible with the funds available it is quite likely that the projects chosen for prosecution will be those making the smallest demands for construction materials; the tendency will probably be to emphasize construction-site employment. The men so employed may even be, in part, men who had formerly been engaged in the manufacture of building materials.

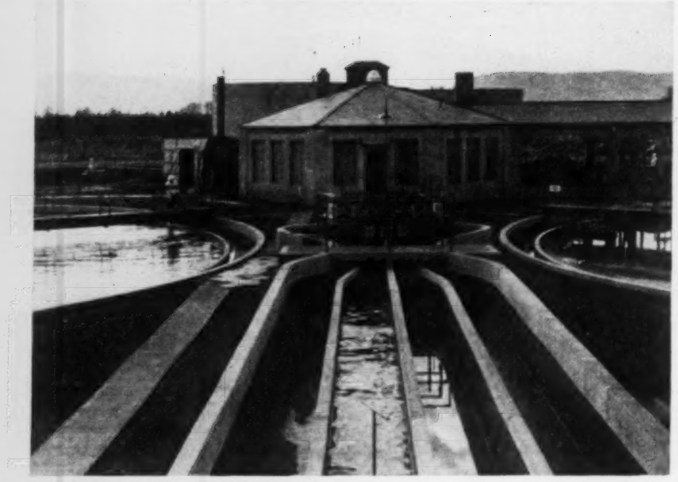
The objective on which focus is sharpest, in both planning and operation, will be of great influence in determining administrative policies. Too sharp a focus upon the creation of employment may lead to policies that will provide less than the maximum of industrial stimulation and less than the best national development. Emphasis upon industrial stimulation may lead to policies not most conducive to the best national development. It is upon national development, therefore, that the emphasis in planning should first be placed. We can be assured that a program planned on such a basis will yield its full quota of employment and of support to the other phases of our national economy.

EACH TYPE HAS ADVANTAGES

On the other hand, to say that we should focus our attention upon national development does not mean that we should exclude the other purposes from the program. The time at which jobs will become available, the kind of employment created, the amount of support to industrial employment, and the relation of these things to each other will depend in some measure upon the projects which compose the program.

For example, studies of Public Works Administration construction by the Bureau of Labor Statistics indicate that street and road projects require 1.4 man-hours of employment away from the site of construction for every man-hour required on the job itself. Steam power-plant construction on the other hand shows a ratio of almost four to one. Between these two extremes lie the ratios of other types of construction, which have been found to be about as follows: residential building 1.5; reclamation dams and structures, 1.6; sewage disposal, 1.9; non-residential building, 1.9; and water supply, 3.3.

Program flexibility, or the speed with which the program responds to efforts to expand or contract it, is dependent upon the type and size of the projects which



© "Municipal Sanitation"

SEWAGE PLANT AT YAKIMA, WASH., A DESIRABLE FORM OF PUBLIC WORKS IMPROVEMENT

Grit Channels in Foreground, Comminutors Left and Right

compose it. Large projects in general are ponderous, both in getting under way and in being brought to an end. The making of plans and specifications takes a long time; early stages of construction may involve the sort of operations that proceed rather slowly; the peak of the demand for labor may not come until many months after work has been inaugurated. The construction period is relatively long and may easily continue into a period of labor shortage. For example there are still under construction, even in these critical times, a number of large projects that were started several years ago, principally because their discontinuance would either present a hazardous situation, as in the case of a half-built dam, or would result in a sacrifice of all the effort previously put into them.

ADVANTAGES OF SMALLER PROJECTS

Smaller projects, on the other hand, get under way quickly, soon reach their peak of labor demand, and are brought to completion in a relatively short time. A program made up of small projects, therefore, could be expanded or contracted rapidly by the simple process of starting a greater or smaller number.

Flexibility is also somewhat dependent upon the type of the projects. Some projects, whether large or small, are of such a nature that construction must be carried through to completion before any utility results at all. For example, a bridge half done cannot be utilized; a water purification plant is of no use until it is completed. Projects of this unitary character must be finished or the work that has been done is largely wasted.

Some projects, however, are of an entirely different nature. Highways, streets, water and sewer lines, and the like can almost literally be built by the yard, and within close limits whatever is completed is of use. Inclusion of projects of this linear type in the program contributes further to flexibility and responsiveness to control.

We may agree, then, that our program should have national development as its principal aim and that within the limits imposed by that aim it should be adjusted to provide the appropriate amount of flexibility and the optimum demand for labor. But how large should the program be?

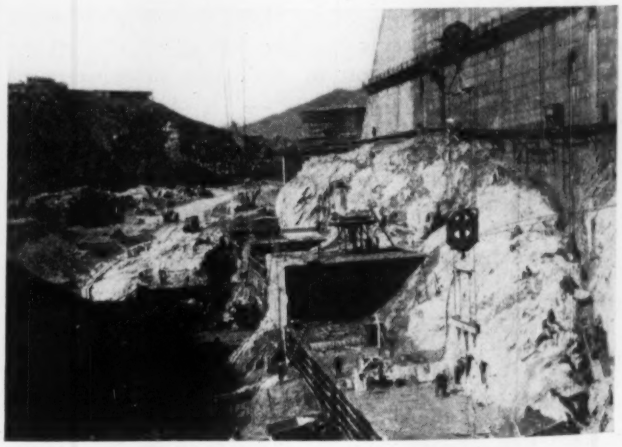
Construction has always played a key role in the development of the nation. Planning for a program of public construction in the post-war period, therefore, means planning for its magnitude and character rather than planning that it shall or shall not be. We can plan for an enlarged program or a program that would emphasize certain types of works but we cannot plan that there will be no public works.

EFFECTS ON EMPLOYMENT CONDITIONS

Although public construction in the post-war period cannot be expected to hold out job opportunities for all who might not otherwise be employed, it can provide such opportunities for many. Experience indicates that when total public construction aggregates more than about $2^1/_2$ billion dollars annually it begins to require the services of workers over and above those upon whom it normally depends. Through efforts designed to expand the more flexible portions of the program, much can be done toward providing an opportunity to be productive to those willing and able to be so. Expansion of this sort might be brought about by an increase in federal budgetary expenditures, by an enlargement of the scope of federal grants-in-aid or loans to non-federal public agencies, by guarantees of state or local government bonds, or by a combination of such measures. The employment that would result would be in proportion to the amount of construction work induced.

A larger and more important aim would be to insure that the construction industry as a whole, public and private, would be called upon to produce at least a certain minimum of value annually. An amount somewhere between 10 and 15 billion dollars seems indicated by experience. To achieve such a goal, not only would federal financial strength have to be thrown behind state and city activity, but it might also have to provide inducements sufficient to call forth the necessary amount of private construction.

Under this arrangement, the total construction volume would be made up of (1) federally undertaken construction, (2) construction undertaken by non-federal public agencies with federal financial support, (3) construction undertaken by non-federal public agencies without federal assistance, (4) private construction supported in part by federal financial strength, and (5) private construction not aided by federal financing. Through adjustments in its own budgetary expenditures, through grants, loans, or loan guarantees to non-federal government agencies and to non-governmental agencies, the Federal Government would seek to assure that the national total of construction would not fall below the figure that seemed most appropriate.



DOWN TO ROCK BOTTOM AT SHASTA DAM

Huge Project Involves Large Expenditures and Much Employment

© U.S. Bureau of Reclamation

Desilting Works at Head of All-American Canal, on Colorado River
Irrigation Uses Predominate in Public Works in the West

One of the most important lessons we have learned since 1933 is that a series of "emergency" programs may easily be self-defeating in achieving our goal. What is needed is a continuing federal policy. But, starting with the first program in 1933, each was set up as if it were the last. The consequence was a sort of "deadline" type of administration, with projects chosen for prosecution in accordance with their degree of readiness and the quickness with which they could put great numbers of men to work, rather than in accordance with the need for, and importance of, the improvement being undertaken. When these two criteria worked together, important and socially valuable community improvements resulted; when they conflicted, community value had to take second place.

It is true, of course, that a quick start was highly desirable for the first program; there were millions of unemployed men completely unprovided for at that time. During the ensuing years, however, the number of unemployed was always much greater than could be put to work by the programs appropriated for, and the need for quick stopping and restarting was not of fundamental importance. The emergency programs were based on the hope that the unemployment problem would be solved in a brief period, but these hopes, experience proved, were not to be realized.

A continuing policy, established by Congress, would have made it possible to plan a public works program for a considerable period in advance. Projects could then have been made ready with the care that important undertakings require; they could have been chosen in accordance with the community values they represented; administration could have functioned smoothly; and the deflationary effects of periodic work curtailment could have been avoided.

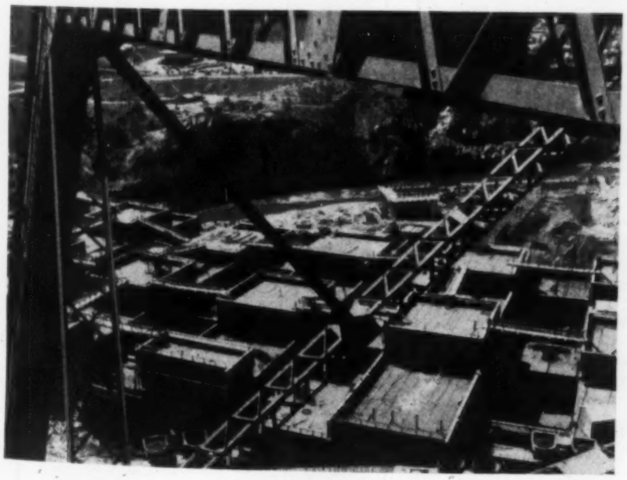
To the National Resources Planning Board has been assigned the responsibility for organizing a planned program of public works to be undertaken when the end of the war makes it possible to devote our energies to the task of building up the nation. With this aim in view, efforts have been directed toward the development, in cooperation with the federal construction agencies, of a six-year program of wholly federal public works coincidental with the preparation of the federal budget, which can be reported in January of any year to the President and to Congress immediately following the annual budget message. The first year of the six-year program conforms to the President's budget proposals for construction in the fiscal year just ahead; the remaining five years call for further development. The details of procedure are already familiar.

Also, procedures for long-range programming suitable for application by state and local governments have been developed and are coming into widespread use.

MODIFICATION AS NEEDS DETERMINE

If public works programming is well done, at both the federal and non-federal levels of government, the adjustment of national policy so as to achieve the aim of employment stabilization will be immeasurably simplified. When fully developed the programming operation will yield information at all times on the extent of the nation's public works activity to be anticipated over a period of years. Federal policies for expansion or contraction may then be determined in that light, to the end that true employment stabilization may be achieved.

For example, if examination of the program should disclose that the total amount of public works construction would be inadequate to fill its rightful place in our national economy, the federal policy might be modified in any one or more of several ways to bring about its enlargement. Federal budgetary expenditures might be increased, the extent of grants-in-aid for non-federal construction might be enlarged, or the scope of loans or loan guarantees might be widened. Conversely, a retraction along any of these lines would bring about curtailment if curtailment seemed most desirable in the interest of a healthy economy.



Vista of Shasta Dam Construction
As Seen Through Steelwork of the Great Head Tower

Navy Warehouse Foundation on Bottom-Bearing Piles with Concrete Tips

By J. H. Thornley, M. Am. Soc. C.E.
President, Western Foundation Company and Western Concrete Pile Corporation, Chicago, Ill.

A LARGE foundation job on metal and concrete piles was recently completed for the Navy. Some 7,200 piles were driven to an average depth of 55 ft, using a plain concrete button or tip at the end of the metal driving tube. A smaller corrugated shell was then dropped inside the tube and sealed to the tip, after which the tube was withdrawn and the shell filled with concrete. The details here given of the driving and behavior of the piles make an interesting record.

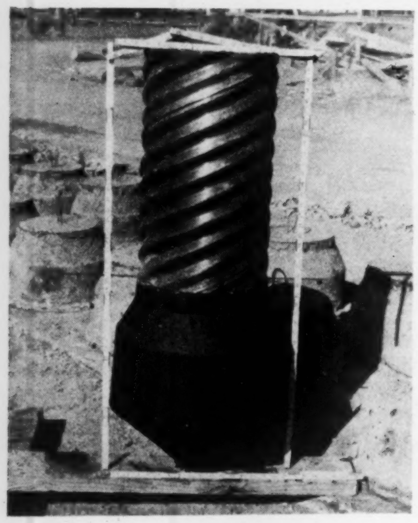
A NEW warehouse in an eastern Navy Yard is founded on over seven thousand piles, each with a bearing capacity of at least 30 tons. The magnitude of this pile-driving job, its planning, and the speed with which it was carried out, make the operation one of particular interest to the foundation engineer.

The main building is 275 by 480 ft, and the concentrations of load required various groupings of piles, with a maximum cluster of 22 under a single column. The minimum spacing is 3 ft and the average is 4.33 ft in each direction over the whole area. This represents an average load of 1.6 tons per sq ft. Hence it was necessary to ensure the support of the structure on a stratum which can sustain such loads, in addition to the natural overburden, without damaging settlements.

A study of the borings revealed that the underlying soil is not uniform. In general, the entire site is underlain by a dense layer of cemented shells, gravel, and clay of considerable thickness, which is capable of supporting these loads. The top surface of this stratum lies at varying depths and is surmounted with softer material and in some cases with thin layers of hard sand, clay, and shell conglomerate.

SEPARATE DRIVING POINT USED

Each pile had a pre-cast button, or point, of unreinforced concrete. It was placed on the ground in proper location and the pile driver was moved so that the apparatus hanging in the 90-ft leads was able to engage it. This apparatus consisted of a steel tubing 14 in. in diameter fitted with a steel shoe which engaged the button. The assembly was driven then as a closed end pile to the required resistance, using a 15,000-ft-lb single-acting hammer. Since the button was slightly larger in diameter than the steel tube, there was no side friction.



Bottom Button of Pile, Surmounted by Corrugated Shell—Note Molding Blocks in Background

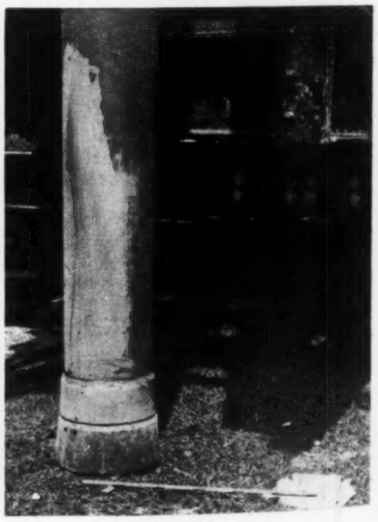
When the driving was completed, the hammer was raised in the leads and a spirally corrugated 18-gage steel shell 12 in. in diameter was lowered into the 14-in. tube. As soon as the shell engaged the shoulder of the pre-cast button, it was immediately sealed against the infiltration of sand and water by the deposit of $^1/_2$ cu yd of concrete in the bottom. The 14-in. tube was then drawn from the ground, and the pile driver pulled itself on its skids into position to drive the next pile. The entire operation took about 20 minutes.

Filling of the shells was done later. This delay allowed time for the inspection of the empty shells and for more convenient delivery of the ready-mixed concrete. The load factor was determined by the bottom bearing only. Any subsequent consolidation of the soil around the piles will serve in time to add to the margin of safety. Undoubtedly the pile is surrounded by a sheath of compressed soil as a result of the driving, and although this material must tend to relieve itself of stress, it is of interest to record that there was not a case on the whole project of a shell being collapsed or damaged by side pressure. The longest pile was 75 ft, the shortest, 36 ft.

The contract called for speed. As it happened, the delivery of steel shells proved to be the limiting factor. Using six rigs, two of which worked a double shift, as many as 179 piles were driven in one day and 822 piles in one week. Occasionally over 9,000 ft of piles were driven in one day. The two rigs selected for overtime work were those which happened to lag in their movement across the site on account of a more thickly crowded pile area or greater pile lengths. This arrangement permitted an orderly progress across the site from east to west and preserved a uniform front without the danger of creating salients or pockets in which the surrounding work would tend to consolidate the soil and increase driving resistance.

The buttons were cast at the site. Two moulding blocks were constructed with forms for 40 and 60 buttons, respectively. Thus 100 buttons were poured at a time from a concrete delivery truck operating slowly past the blocks. The use of high early strength cement permitted removal of the castings within five hours to a space allotted for curing and storage.

Shells were delivered from rail-



Start of Driving Operation—Button on the Ground and Steel Driving Tube in Place

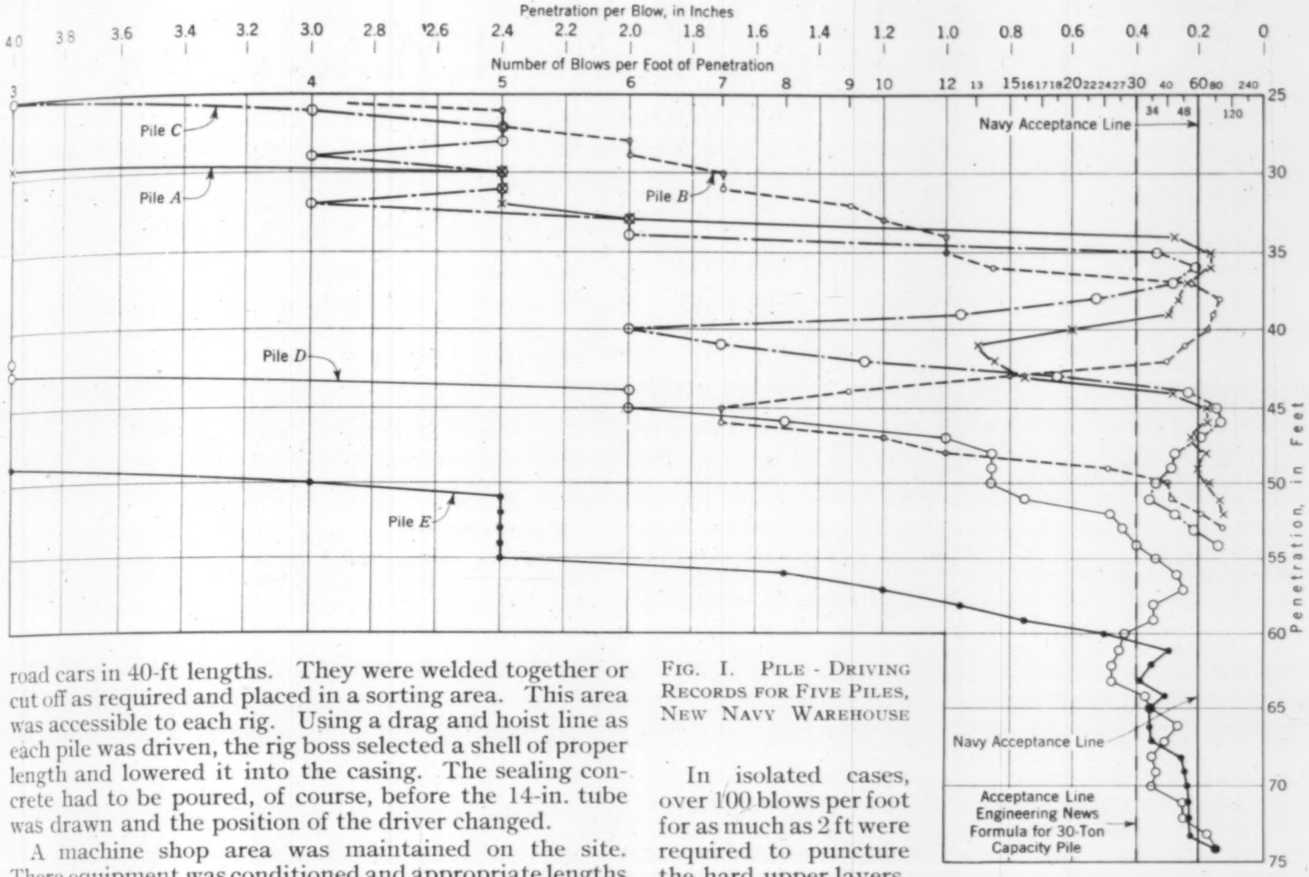


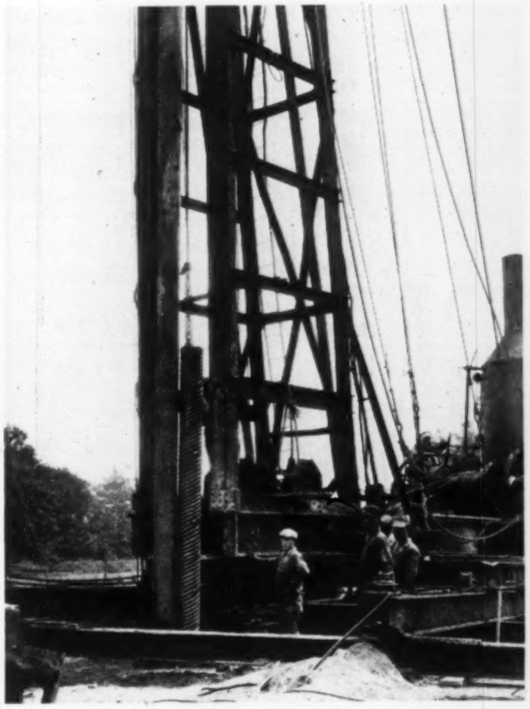
FIG. 1. PILE - DRIVING RECORDS FOR FIVE PILES, NEW NAVY WAREHOUSE

road cars in 40-ft lengths. They were welded together or cut off as required and placed in a sorting area. This area was accessible to each rig. Using a drag and hoist line as each pile was driven, the rig boss selected a shell of proper length and lowered it into the casing. The sealing concrete had to be poured, of course, before the 14-in. tube was drawn and the position of the driver changed.

A machine shop area was maintained on the site. There equipment was conditioned and appropriate lengths of 14-in. pipe were kept readily available and fitted with driving shoes.

For the driving behavior of the piles, reference is made to Fig. 1, which shows the record of five typical piles. The specifications required driving to 60 blows to the last foot (5 blows per in.). Also the levels at which this resistance was to be expected and would be acceptable were predetermined from the boring data and tests. Note that Pile A was driven through one of the hard strata at a 35-ft depth. This pile would have been acceptable for the bearing load developed under the Engineering News formula at a penetration of 34 ft; further it would have met the Navy's required resistance at 35 ft. The hard layer was penetrated, and at penetrations from 39 ft to 44 ft the driving was much easier, failing to meet either specification. Then the resistance increased, and the final penetration was 52 ft.

Piles B and C were similar. Pile D met the requirements of the Engineering News formula at 54 ft, failed to meet it between 60 and 64 ft, but did not satisfy the job requirements until it reached 74 ft. Pile E was also driven to 74 ft, although it would have satisfied the Engineering News formula at 61 ft.



PILE ALMOST COMPLETED—SPIRAL SHELL IN PLACE AND STEEL CASING REMOVED
Shell Will Now Be Cut Off and Filled with Concrete

In isolated cases, over 100 blows per foot for as much as 2 ft were required to puncture the hard upper layers, and this severe test was a demonstration of the value of the unreinforced concrete buttons. The driving records show clearly how the requirements resulted in the successful penetration of the hard layers which overlaid softer material.

The job was started on August 6, 1941, but the first three weeks were needed for organization, setting up rigs, and driving test piles for demonstration. Progress really began on August 27, and the last pile was driven on November 14. In 54 working days, 7,232 piles totaling 400,986 ft, were driven. If this is not a record, it is at least noteworthy as the largest installation to date of this type of 30-ton pile.

The project is being constructed for the Navy under the Bureau of Yards and Docks. Rear Admiral Ben Moreell (CEC), U.S.N., is chief of this Bureau. Capt. A. K. Fogg (CEC), U.S.N., was Public Works Officer of the Navy Yard during the foundation work. Lt. J. V. Ryan (CEC), V(S), U.S.N.R., was Resident Officer. The Rust Engineering Company is the general contractor for the Navy. Charles Franc was general superintendent in charge of the pile driving, which was performed by the Western Foundation Company, subcontractor.

Conservation of Critical Materials in Construction

By J. H. Ehlers, M. Am. Soc. C.E.
Technical Specialist, U.S. Department of Commerce, Washington, D.C.

Entirely new conditions have been thrust upon the construction industry by the war emergency. When steel and other materials were plentiful, breakdowns of cost in terms of dollars were sufficient, but now dollars are plentiful and ingots are scarce. The result is a vital need for studies to determine the total estimated consumption of all the principal materials used in construction in order to allocate the required quantities for essential proposed construction work. Mr. Ehlers goes on to suggest a number of ways in which critical materials may be conserved. This review is based on a talk before the National Homes Foundation last December.

The war has introduced a new era of construction planning, an era in which construction must be budgeted in terms of expenditure of critical materials as well as of dollars. This does not mean that dollar expenditures can be ignored, but it suggests that it will be even more difficult to obtain approval for a project from the viewpoint of the materials that will be needed than from the viewpoint of the money that will be needed.

In the past, Government and private construction agencies have submitted their estimates to budget officers and have revamped the details of projects to fit the monetary budget. Now they must be prepared, further, to submit their proposed consumption budget of materials to authorities responsible for conserving critical materials, and must if necessary revamp plans to bring them within the allowable material expenditure. The War Production Board is the guardian of our supplies of materials and acts as the budget office.

Conservation of the critical metals in construction may be accomplished by (1) controlling the volume of construction, (2) removing or modifying various barriers to the economic use of these metals, and (3) using substitute materials and making radical changes in design.

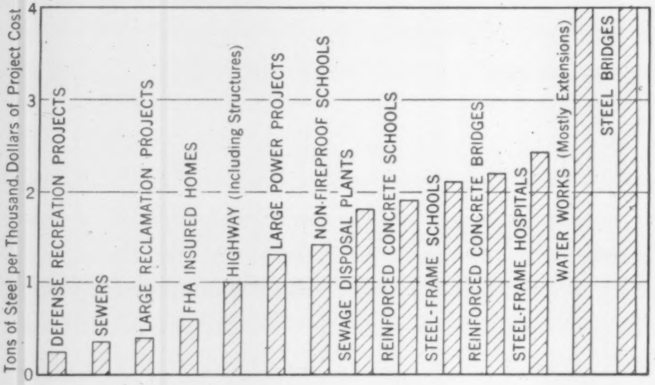


Fig. 1. Iron and Steel Used on Some Selected Construction Projects, 1936–1941

CONSERVATION THROUGH CONTROL OF VOLUME

In any effort to conserve materials by reducing the total construction volume, a much more rational job can be done if the types of construction which use excessive amounts of critical metals are known. Elaborate breakdowns of structures into component parts on a cost basis are available, but there are few such breakdowns on the basis of quantities of materials used. While it is not too difficult to obtain tonnage figures on metals in the major structural parts of a project, very little is known about the weights of component metals in the fixed equipment which constitutes a part of the structure.

Rather to stimulate thought in this important field than to give any authoritative information, a few crude computations have been made of typical groups of structures to determine the total amount of steel used. The chart (Fig. 1) relates to various structures of recent years on which some federal financial assistance was rendered and may well serve as a starting point for consideration of the problem. Fixed equipment only is included; land costs are excluded.

A general idea of the estimated value of construction activity of various sorts in the United States since and including 1929 is given by Fig. 2. In Fig. 3 is shown the use of iron and steel on various types of construction in 1941 and 1942.

The Federal Housing Administration has made a careful analysis of one-family houses covered by its mortgage insurance. Based on these figures, the weight of iron and steel products is estimated at about 0.6 ton per $1,000 of construction cost (excluding land), of which about 0.37 ton consist of steel products and 0.23 ton of cast iron. About three-fourths of the steel and one-third of the cast iron are in structural parts, excluding equipment. In addition to the steel and iron products used, the total amount of copper is 0.02; zinc, 0.01; and lead, 0.01 ton per thousand dollars of building cost.

Some estimates made for a large highway program about the middle of 1941 indicated the use of about one ton of steel per thousand dollars of construction cost, distributed as follows: culvert pipe, 0.06; reinforcing steel, 0.49; structural steel, 0.47. Of the total steel used it is estimated that 75% is in bridges of 20-ft span or over.

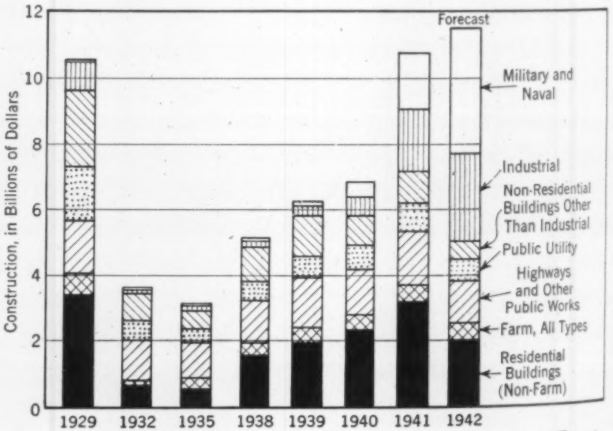


Fig. 2. Value of Construction Activity, by Types, in Continental U.S., Estimated by U.S. Department of Commerce

Several government construction agencies are developing estimates of the quantities of materials used on their projects. The information is needed to justify particular projects, and to provide a broad background of information to enable the authorities to determine the amount of defense housing and civilian construction of various kinds that can be expected, or permitted, from a given supply of critical metals. It is urged that construction agencies both public and private make such analyses.

HOW MUCH STEEL IN CONSTRUCTION?

With reference to steel in particular, an urgent need has arisen to know how much is currently being used in construction. The figures ordinarily published, based on shipments by the industry, are deceptive, for only known construction destinations are credited to construction. Shipments reaching construction through jobbers and through other industries are not shown under construction. Hence the figure of 5 million tons published by the American Iron and Steel Institute as shipped to construction in 1940, should be increased by at least 3 million tons to arrive at a total.

Table I is offered as a working hypothesis pending results of more extended and detailed studies. It is an attempt to apply steel factors to estimates of the total construction volume of the continental United States as developed by the Department of Commerce. As it is based on a limited number of rough calculations, it is subject to major revisions; but it is probably accurate enough to serve as a measure of the total steel requirements for construction, and as a guide for formulating general policies.

Recently experts from the steel industry, in cooperation with various government officials, made an estimate on total shipments to construction, including products moving through jobbers and other industries, and their estimate is in rather close agreement with the figures arrived at by applying the steel factors to the construction estimates.

In Table I the 1941 factor for private residential construction is based on the Federal Housing Administration studies, with some adjustments to exclude land costs. FHA estimates that a 10% reduction in steel is being effected through the application of the Defense Housing Critical List. The factor for 1942 has been reduced somewhat, in the belief that further economies will be effected over those obtained by applying the critical list, and that some housing will be built without priority assistance, using smaller amounts of steel and iron.

TABLE I. ESTIMATED USE OF IRON AND STEEL IN NEW CONSTRUCTION

CLASS	CONSTRUCTION VOL. MILLIONS OF $		IRON AND STEEL, TONS* PER $1,000 OF PROJECT COST		TOTAL IRON AND STEEL,* THOUSANDS OF NET TONS	
	1941	1942	1941	1942	1941	1942
Private:						
Residential	2,700	1,300	0.6	0.5	1,620	650
Commercial	300	150	2.0	1.5	600	225
Industrial	600	200	2.6	2.4	1,560	480
Other non-residential	220	100	1.5	1.3	330	130
Farm	540	500	0.2	0.18	108	90
Utility	870	550	0.8	0.7	696	385
Public:						
Residential	500	700	0.4	0.3	200	210
Industrial	1,300	2,500	2.2	1.8	2,860	4.500
Other non-residential	370	250	1.7	1.4	629	350
Military and naval	1,760	3,900	1.2	1.0	2,112	3,900
Highway	1,000	700	0.8	0.5	800	350
Other public works	640	550	1.0	0.7	640	385
Total	10,800	11,400	...	...	12,155	11,655
Estimated cast iron	....	....	....	....	1,390	900
Total steel					10,765	10,755
Ingot tonnage†	....	....	....	....	15,380	15,365

* These figures relate to finished steel products.

† Finished steel tonnage divided by 0.7.

Bureau of Reclamation Photo

EARTH AND ROCK-FILL DAM WHICH USES MINIMUM OF CRITICAL MATERIALS
Tieton Dam, Yakima Project, Washington

As for private non-residential construction, the 1941 conversion factors for commercial, industrial, and other non-residential buildings are derived from computations on large public buildings and on some structures built during the defense program, partly with government funds. The industrial-buildings factor is high, because this type of construction has involved much heavy structural steel work. For 1942 these factors are reduced to allow for a shift from structural steel to reinforced concrete construction and for other proposed economies.

Public residential construction is assigned a lower factor than private housing, because of the emphasis in the former on low-cost housing and the inclusion of buildings of the dormitory type. Public industrial buildings are assigned a lower factor than private, because of the inclusion in the public type of large numbers of small brick or concrete structures of the sort used at powder and ammunition plants.

Naval and military construction is based on the application, among other things, of factors developed by the War Production Board from rough analyses of actual structures. The highway factor is reduced from 1 ton per thousand dollars, computed for a large federal-aid program, to 0.8 ton, to allow for county and road work using less steel. It is still further reduced to 0.5 ton for 1942, in the belief that a considerable volume of road work will be carried on with substitute materials, especially in the matter of steel for bridges.

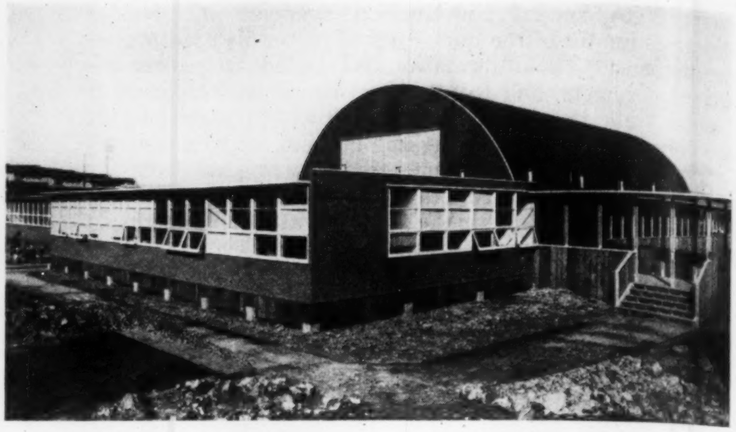
SOME ALLOWANCE MADE FOR SUBSTITUTION OF MATERIALS

In all the 1942 factors, some allowance has been made for an expected substitution of materials. In certain instances, where the volume in a particular category is to be reduced drastically, the factor may not be reduced, construction being limited to that carrying high priorities. In other cases it is believed that a large volume of work will be carried on with a high degree of substitution of materials, resulting in a lower steel factor.

It must be understood that the factors in Table I are not the result of elaborate staff work and are not to be regarded as hard-and-fast computations for use in engineering estimates. The data on which they are based are not comparable in time of construction, but range over a period of six or seven years, with only approximate adjustments for price changes. The weights of iron and steel per thousand dollars of cost for plumbing, heating, and machinery are rough estimates which later checking may change considerably.

One of the important objectives in presenting these data at this time is to inspire groups who are responsible for the construction of various types of projects to work out the problem, each in its particular field, so that ultimately the operations of the construction industry may be recorded and forecast in terms of a "bill of materials." It is hoped that this may be developed for all basic materials as well as for the hours of labor of the various building trades.

Custom and law have imposed many restrictions on uncontrolled construction, some of which constitute the foundation upon which building has grown from a crude art to a highly scientific one. These restrictions cannot be discarded at will; but they should be subjected to analysis in the light of current developments. Building codes present an interesting field for study in this connection.



Federal Works Agency Photo by Highton

LARGEST PREFABRICATED DEMOUNTABLE SCHOOL HOUSE EVER ASSEMBLED USES MINIMUM OF CRITICAL MATERIALS

War Public Works Project Serves Defense Workers at Vallejo, Calif.

The specifications for some materials in respect to allowable stresses and minimum dimensions, for example, have not kept pace with improvements in the quality of those materials. Also durability and permanence have normally been paramount considerations. It is believed that for structures whose usefulness will terminate with the end of the emergency period, higher allowable stresses in design are consistent with the emergency needs.

REVISION FOR LOCAL BUILDING CODES

An interesting field is opened up by the materials shortage in determining just what can be done in revising local building codes so as to use as little of the critical metals as is consistent with sound design principles and to assure the safety of the population.

Although much work has been done toward formulating nationally applicable code principles, and great service has been rendered by the federal government, their revision is a matter essentially outside federal authority. Both from legal and practical considerations it is a local problem. However, under the present emergency conditions, one essential factor in all construction, the supply of critical metals, is subject to a priority system directed by the federal government. Since such a system is essential to get necessary metals for a needed project, the federal government has become the key in determining details of building construction through its determination of the amount of metals to be allowed. The development of the critical list for defense housing is a step designed to promote a consideration of restrictions in the codes.

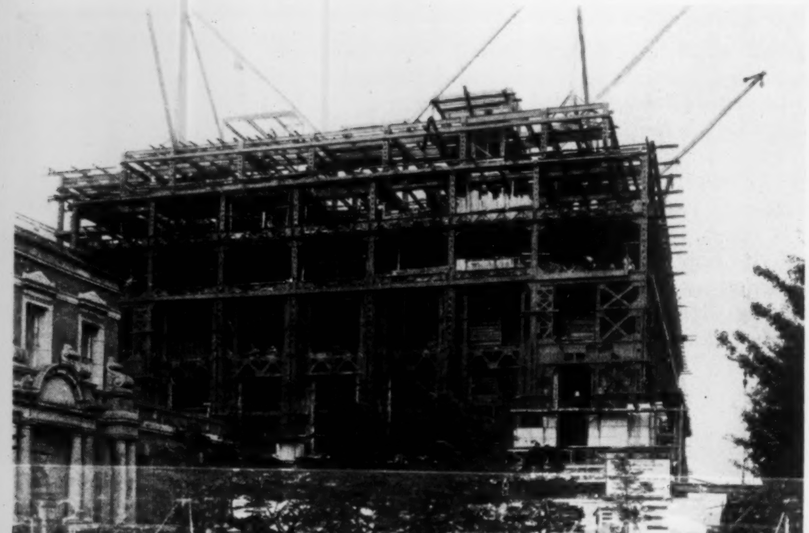
One of the most important places where metal can be saved is in the plumbing system. Such possibilities were amply demonstrated by the Plumbing Manual developed by the National Bureau of Standards before shortages of critical materials became a serious problem, and designed to effect such economies as were consistent with high standards of safety and performance. It indicates that substantial savings are possible.

This manual has been adopted as the code for federally financed residential construction. In order to avoid depriving the citizens of any municipality of housing because their plumbing code requires the use of more metal than the amount for which priority can be obtained, the master and journeymen plumbers have tentatively agreed with the War Production Board to urge the adoption of local codes which accomplish much the same purpose, for the duration of the emergency.

That some standardization is needed, is indicated by the discrepancies in the minimum amounts of metal required under various existing municipal plumbing codes. For example, an analysis of the codes of a dozen cities selected at random shows that the city requiring the lowest weight of metal on a one-story house saves 100 lb of cast iron, or about 30% of the total required by the city having the maximum code requirements. It also saves 10 lb out of the 50 required by the maximum code of metals other than cast iron. Thus, if the various municipalities would simply check their plumbing codes against the existing codes of other cities they might find many items on which metal could be saved.

The proposed code approved by the plumbing industry for the emergency makes still greater savings. It is important to note that nearly every saving featured can be found in actual operation in some cities at the present time. In other words this code is not, as has been stated, a radical departure from existing practices nor does it throw overboard the accumulated experience of builders. This proposed emergency code saves, on a one-family one-story house, up to 150 lb, or 45% of the cast iron, and 35 lb, or 70% of other metals in comparison with the city codes mentioned. It saves about 25% of the metal required by the local codes which had the lowest requirement of metal.

In the case of hardware and, to a certain extent, of electrical materials, savings may be effected by manufacturers by revising designs and standardizing sizes to



EARTHQUAKE-PROOF STRUCTURE (TOKYO)—HEAVIEST STEEL USER IN THE BUILDING FIELD use less of the scarcer metals, especially copper and brass.

Important savings can be made through the substitution of less scarce materials for critical metals and through radical changes in design of structures. However too much should not be expected, over a short period of time, from the development of entirely new materials. An alternative material will not serve for a current material in all its many uses. Different substitutes may be required for a single material in its different uses.

In general, the substitute material should be one that is produced in quantities as great as the original material in the particular use for which the substitution is made. To substitute a material produced in small volume for one produced in large volume tends to create an even greater shortage of the second material. There are many exceptions to this, but it is a caution worth noting. For example, attempts to substitute plastics for steel has led to a shortage of plastics without relieving the steel situation to any appreciable degree.

Also substitution for materials in a relatively simple rather than in a highly worked state is desirable. The highly worked materials show a lower weight of metal per dollar of expenditure. Thus it is more effective to find a substitute for the iron in cast-iron pipe than for the iron in an expensive piece of machinery.

It may be possible to increase the use of higher-strength steels where a given amount of the basic scarce material serves a more effective use by additional processing, or by alloying where the added materials are available. Surface treatment of metals may be used in place of alloys where protection rather than strength is needed.

STANDARDIZATION OF SIZES AND OTHER METHODS

Standardization of sizes to permit more economical manufacturing and distribution, requiring smaller stocks to be carried, is an important conservation move. It is possible that considerable help may be obtained through more efficient salvaging of waste materials, such as junked automobiles. It might be possible to require the turning in of old pipe and plumbing equipment when new material is purchased for modernization or repairs. Hundreds of miles of abandoned railway trackage could supply steel needed elsewhere.

Progress is being made in the substitution of plastics and glass for copper and brass; enameled steel and electroplated products for sheet copper; wood for steel in miscellaneous items like fences and poles; brickwork for small steel and reinforced concrete columns; reinforced concrete for steel structures; and plain for reinforced concrete. During recent years there has been considerable experience with asbestos-cement pipe as a substitute for metal pipe in water supply systems, and its use is suggested as a conservation move during the metals crisis. Note, for example, the high consumption of steel for water works projects previously mentioned.

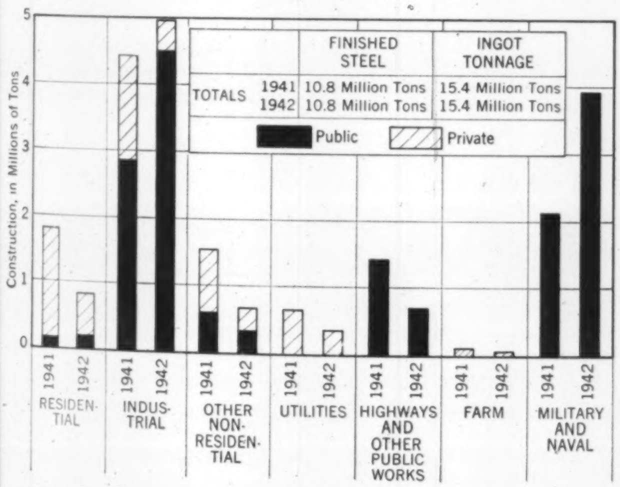
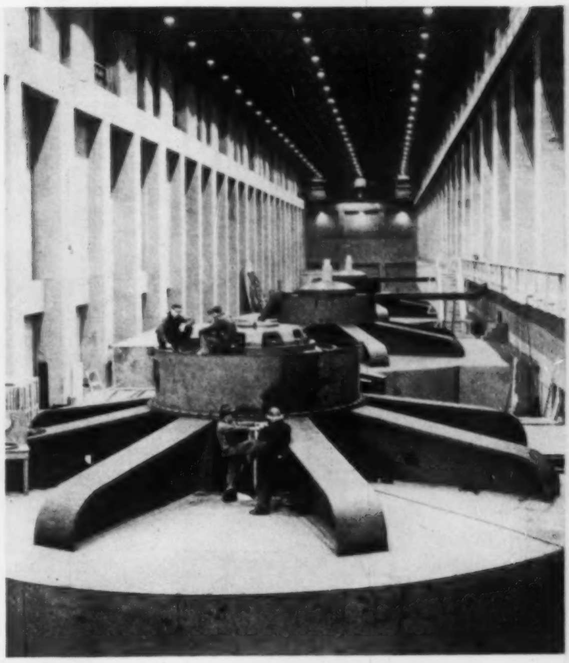


FIG. 3. USE OF IRON AND STEEL IN CONSTRUCTION IN CONTINENTAL U.S., 1941–1942



THIRD GRAND COULEE GENERATOR (108,000 KW) WENT INTO OPERATION ON APRIL 7, 1942

Such Use of Critical Materials Is Justified by War Industries' Need of Power

While, in a highway program, a considerable saving can be made by replacing the metal culverts with brick or concrete and by eliminating most of the steel from the road slab, it is apparent that large savings must be effected in the bridges if a large net saving is to be accomplished. This would naturally suggest reinforced concrete for short and medium-span bridges where clearance and other conditions permit. On a considerable mileage of the highway construction needed during the coming year it will be possible to use existing bridges.

There is much room for the exercise of ingenuity in substituting reinforced concrete for steel structures and plain for reinforced concrete. It may be somewhat contrary to the training of engineers who design for minimum cost; but under present conditions the real skill of the designer may better be brought out by designing structures which will obtain priority approval by virtue of their low metal requirements.

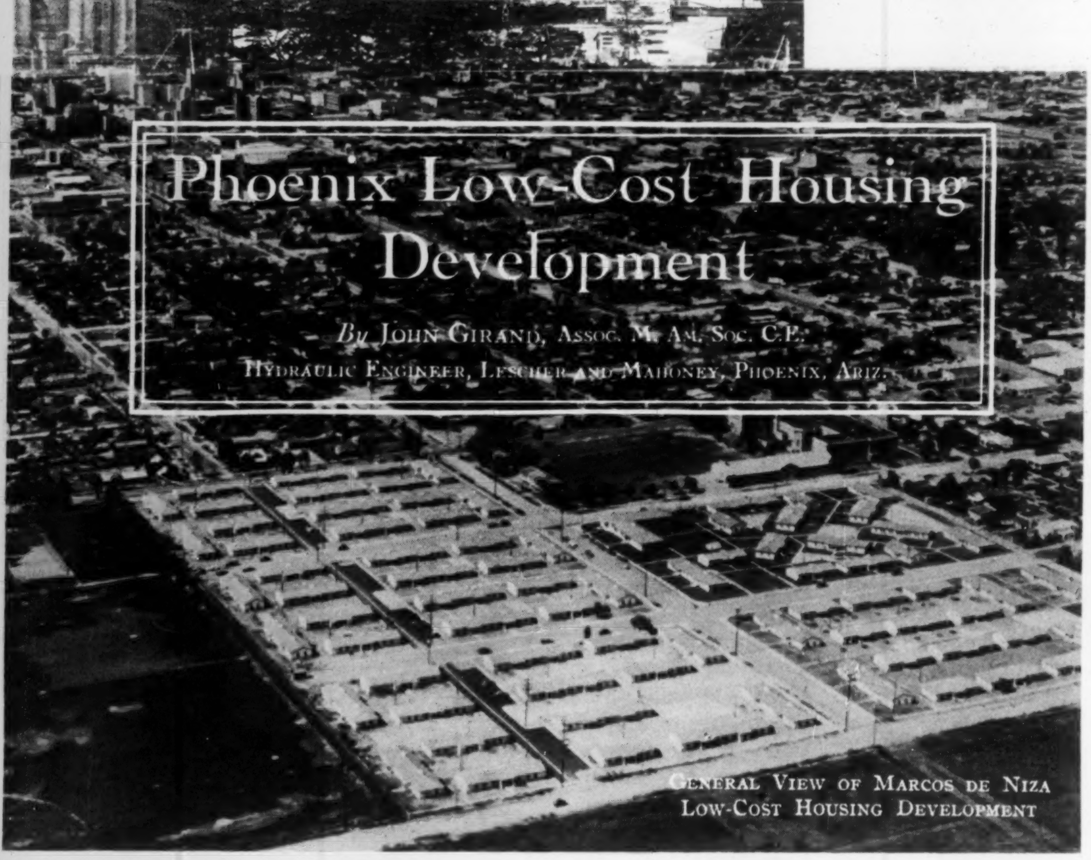
The Federal Housing Authority estimates that a saving of 10% of the iron and steel, 62% of the copper, and 28% of the zinc can be made in the average dwelling without lowering the standard of construction. In the structural part proper, 23% of the iron and steel, 55% of the zinc, and 99% of the copper can be saved.

In connection with reinforced concrete designing, such items as providing thicker slabs and deeper beams in order to save reinforcing steel naturally suggest themselves. Timber and laminated timber trusses can be used for steel. Creosoted wood sheet piling can be used in many cases where steel sheet piling is now used. If the necessity becomes urgent, new schemes can be developed that present circumstances do not warrant considering. It is reported that in Europe glass pipes are being used in houses instead of metal ones and that many other items, such as house bells, are made of glass.

Conditions may change and other materials become critical. Even now certain local shortages are developing for cement. Transportation may become a bottleneck as it was during the last war, and dictate the use of local materials. New developments outside the construction field may release additional supplies of the critical materials. For example, studies are being made of copper-bearing steel shells and if these prove successful the copper situation will be less critical. The whole situation is a challenge to American engineers and to government construction agencies.

Phoenix Low-Cost Housing Development

By John Girand, Assoc. M. Am. Soc. C.E.
Hydraulic Engineer, Lescher and Mahoney, Phoenix, Ariz.



General View of Marcos de Niza Low-Cost Housing Development

FOR one hundred and fifty years the people of the United States have lived under a system of economic individualism based on the fundamental principle that each man should rise or fall according to his own efforts. It was every man for himself, and the devil—or the poor house—take the hindmost. In this ruthless struggle for existence each individual gave his best efforts, with the total result that the average standard of living in the United States is higher than that in any other country in the world.

It is necessary to emphasize the word "average"; it was the average, not the minimum, standard of living that was highest. For in the competitive struggle between millions of men, not all could become bank presidents or even bootblacks—some were condemned at birth to the filth, squalor, and ignorance which is today found in the blighted areas which we call "slums."

The prisons are full of individuals who started their careers in the "slums." Juvenile delinquency courts deal almost exclusively with the products of the "slums." Public health officials deplore the conditions in the "slums."

That slums were allowed to exist was primarily because a rational and economic solution to the problem could not be worked out. Until a few years ago, it was thought impossible to provide reasonably decent houses for the low-income class. The "standard" type of house for one family was far too expensive to build. Maintenance was too expensive; operation was too expensive; the life of the project was too short.

ENGINEERS DESERVE CREDIT

Briefly, the problem of eliminating slums became a problem of developing low-cost housing. The building of houses has usually been considered by engineers to be the field of the architect, but it is a significant fact—and a fact that should make engineers proud—that the solution to the low-cost housing problem has been solved primarily by engineers, working on engineering principles. As an example, the Phoenix low-cost housing project is under the general executive direction of an engineer; the site plan was laid out by an engineer; the roof trusses were designed by an engineer; the plumbing, heating, and ventilating were designed by engineers; and engineers were employed as construction layout men, inspectors, and material testing men.

The Phoenix low-cost housing development consists of three separate projects, located in three separate parts of the city: the houses for colored people located about one mile southwest of the center of the city; the Mexican housing project, about one mile south of the city, near the Mexican schools and community; and the project for white people, about two miles east of the business district, in a stabilized residential area. The selection of these sites was not made on the basis of the cheapest possible land that could be bought today, but on the basis of the cheapest land that could be bought considering the life of the project.

Just as houses can become obsolete and undesirable, so whole areas can become undesirable, and the sites must be selected to prevent, as far as possible, the encroachment of any such undesirable areas on the project itself. For example, the Mexican project is protected along the west by a city park, on the north and part of the east by a city grade school, and on the south by the city limits. Only by a major change in city planning and zoning could adjacent areas become blighted and thus affect the desirability of the project itself.

Some confusion has existed in the minds of a few people concerning these site selections. The colloquial term "slum clearance" indicated to these people the tearing down of blighted areas and rebuilding on these same areas, whether they were suitable or not. Good engineering practice would say to tear down the slums and build the new houses in the best possible location. Such is the practical working of the slum clearance idea: for every new house built, one substandard house must be destroyed—but not necessarily on the same lot.

After the site was selected, the houses were arranged on it to give maximum livability with minimum cost. The houses are arranged around courts, facing a grassy play area for children. The back yard is a patio with utilities—sewer, water, gas, and electricity—brought to the rear of the houses. Clothes lines for wash day are provided, and yard lights for long summer evenings; off-street parking, to reduce traffic congestion; garbage stations, adequately fenced; sidewalks for ease of circulation; and small parks with sitting areas.

TO SECURE LOW COSTS

But the key to low-cost housing is in the houses themselves. Those sticks and stone, bits of wire and

GREAT credit should go to the engineer for his work on low-cost housing, if the Phoenix projects are at all typical. Details, according to Mr. Girand, were given exhaustive scrutiny as demanded by the magnitude of the 2,000-room job. So closely were details scrutinized that one added brick per room was recognized as involving an increase of $100 in the total cost. Similar care with materials and inspection helped to secure what is said to be America's lowest-cost development. This paper was on the program of the annual fall meeting of the Arizona Section at Phoenix, Ariz., last November.

Typical Alley in Phoenix Low-Cost Development

A Front Courtyard, Serving a Number of Houses

pipe, glass, doors, and paint, did not assemble themselves into a building. There was no "luck" in the fact that the Phoenix development is the lowest-cost housing development in the United States. This result was achieved only by hard work and long hours of the best designing talent available. The experience of hundreds of engineers on past developments, meticulous attention to details, and a careful consideration of cost and present construction practice were necessary.

It was not enough merely to design a roof truss that would support the required load—the members had to be cut from commercial-length timbers so that the piece left over could be used for one of the short members of the truss. For a project with 2,000 rooms, a detail which would add only one dollar to the cost of a room would add $2,000 to the cost of the project. With prevailing prices of brickwork, the addition of just one extra brick per room would increase the project cost one hundred dollars. In other words, when designing a house with brick selling for one hundred dollars each, obviously a certain amount of care is required in fitting doors and windows into the brickwork.

Not only is care in designing necessary to insure low construction cost, but proper materials must be used to guarantee long life. The average residential house is built and financed to last twenty years. The total cost is spread over a twenty-year period and made in annual payments. If the same house were so designed that it would last 60 years, and the total cost spread over 60 years instead of twenty, the annual payments would be reduced to one-third.

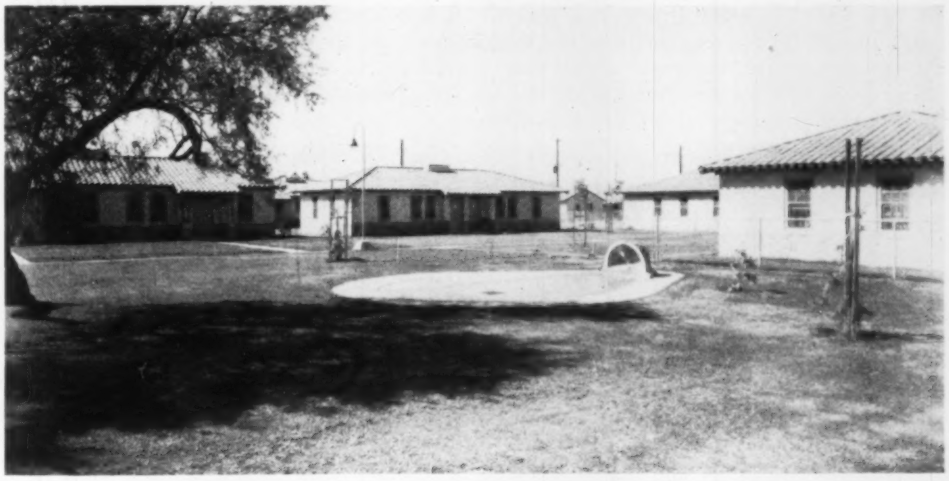
Low-cost housing must be built to endure over long periods of time in order to reduce the annual charges to a minimum. The Phoenix projects are designed to have a life of 60 years, and to insure such life, rigid specifications of substantial materials are required.

An illustration of the substantial nature of the buildings can be given by comparison with wrecking methods used on other buildings. When an old building in town is demolished, a crew of men with wrecking bars tear down the brick walls and stack the reclaimed brick for use elsewhere. On the Phoenix housing project, when it was necessary to enlarge a wing of the administration building, one wall had to be torn down. Men with wrecking bars failed to make any kind of an impression on the wall, and in the end the wall had to be pulverized with sledge hammers. It seems reasonable to assume that buildings that can stand up against a crew of men with sledge hammers will have a life somewhat in excess of the ordinary house constructed with studs, chicken wire, and plaster.

Another example of the stability of the buildings is in the detail method of securing door jambs. The opening and slamming of doors cause severe impact shocks on the jamb itself, and after a few years of use this is usually a source of trouble in the ordinary house. The Phoenix low-cost housing project provided steel anchors for door jambs, keyed into the masonry at the time it was laid. With six steel anchors on each door—over 12,000 on the entire job—the possibility of door jambs working loose is reduced to a minimum.

An interesting detail was developed on the Phoenix project to insure long life for the paint. It has long been known that paint will not last properly if applied to a wet surface, but no method was in practical use to determine how wet or how dry a wall actually was just before the paint was applied. With the assistance of J. W. Powers, M. Am. Soc. C.E., of the Arizona State Highway Testing Laboratory, a new calibration curve for a standard moisture meter was worked out. The moisture meter can be pressed against the surface to be painted and the moisture content of the masonry wall read directly in percentage. Specifications required the inspector's approval of wall moisture content before any paint was applied.

In connection with the painting of the project, a new specification was worked out to insure that each room received the proper three coats of paint. With two thousand rooms and a hundred or more painters, an inspector can be kept rather busy running in and out of rooms to see if the first or second or third coat has been applied.



Children's Play Area and Spray Pool, Phoenix Development

Administration Building, Marcos de Niza Project

The new specification stated in effect that the paint was not on the wall unless the inspector saw it put on, a specification rather discouraging to the type of careless workman who will slap on only one coat and call it good enough. A check chart system enabled the inspectors to certify each coat of paint for every room—three coats on 2,000 rooms, the equivalent of 6,000 coats of paint!

LIVING QUALITIES ESSENTIAL

The stability of the buildings, guaranteed by quality materials and rigid inspections, would not alone insure the success of the projects—it was necessary that they be made livable. A jail is certainly a very stable and permanent structure but few people seem to want to live there permanently. Livability is secured by proper design with attention to convenience, living space, ease of maintenance, and adequate room for each member of the family.

Not all the buildings are the same size. Some are for a single couple, and others are for people with families. One, two, three, or four bedroom units are available, with rooms designed to give proper space for two persons per room. The percentage of one, two, three, or four bedroom units to the whole project was determined by a survey of the total population in Phoenix living in substandard homes, divided into proper racial groups. This survey brought out one astonishing fact concerning the slum conditions in Phoenix: on one city lot, size 50 by 150, in the slum area, one hundred and thirty-two people were living, served by one water faucet and one privy. Not all the slums are in the east side of New York.

The kitchens are scientifically designed; they are called "two-step" kitchens; that is, all cooking operations can be carried out with a minimum of walking back and forth between refrigerator, work table, sink, and stove. Shelves over the working area provide storage, and an entire meal can be prepared with literally no more than "two steps" required, as all tools and supplies are near at hand. Simplification of the kitchen procedure not only makes a more modern and desirable kitchen, but reduces the first cost and the maintenance and operating cost of the project.

Living rooms are spacious, with adequate window lighting, and proper wall space for furniture. Space heaters, gas operated, are provided in the living room. The bedroom for the father and mother—the master's bedroom—is designed to allow space for the baby's crib. Other bedrooms are of such size that the larger children will have proportionately more space than the smaller children. Linen shelves and utility closets for storage are included.

Bathrooms have built-in tubs with tile borders, lavatory, and water closet, with a medicine chest of steel. It is an interesting fact that more bath tubs were installed in these projects than existed in the entire area "south of the tracks"; the resulting improvement in health in these areas should be marked in the next few years.

Because Phoenix has a climate that allows a great deal of outside living, play areas for children were equipped with spray pools, wading pools, and grass lawns. Community facilities include assembly halls, workshops for learning crafts, library and, in the white project, a medical clinic.

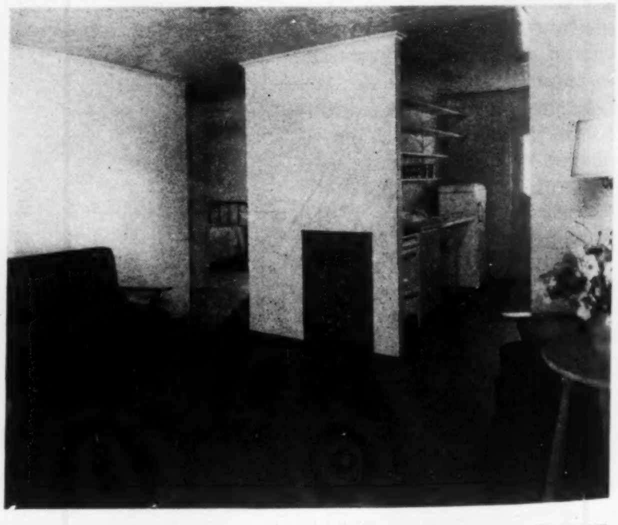
HELPING TO REDUCE COSTS

One great misunderstanding must be cleared up. These apartments are not being donated free to the people who inhabit them. The rentals are so low that it seems like a gift, but these low rentals are due to the fact that the houses are low-cost houses, with resulting low monthly costs for interest and amortization, maintenance and upkeep. Their great desirability keeps the vacancy factor low—further reducing rents. Purchase of gas and electricity on one meter at wholesale rates results in a great saving over the conventional method of individual metering. Heating costs are kept low by providing proper insulation so that the buildings can be kept warm for half the cost of the usual residence.

The City of Phoenix has remitted taxes on the projects, but as these areas were "slums," the taxes formerly collected from them were negligible. The city also provides water free of charge, but the amount of water consumed by the project is less than the normal loss suffered by the city through leaky water mains. Construction costs are advanced by the Government—and few projects in the last ten years have not been financed by the Government!

For the three projects the total cost was $1,800,000. Of this, $1,380,000 went into construction. The colored project, housing 150 families with 500 people, was built for $360,000: the Mexican project, housing 224 families, with 950 persons, cost $500,000; and the white project, to house 230 families with 700 persons, is costing $520,000. Initial construction was started in June 1940, and all units were occupied by the end of 1941.

The project is under the general direction of Howard S. Reed, M. Am. Soc. C.E., as construction adviser for the U. S. Housing Authority. George Phelps is the supervising architect; Walter Johannessen was in charge of site engineering; and the writer was engineer for Lescher and Mahoney, project architects.



Interior of Living Room and Kitchen, Bedroom in Distance

Highway Construction in the Post-War Period

By G. Donald Kennedy, M. Am. Soc. C.E.

Commissioner, Michigan State Highway Department, East Lansing, Mich.

A GREAT industrial state like Michigan is faced with baffling problems created by the impact of war on its normal business economy. That it should at the same time be preparing for that better day which will follow the war is evidence of a constructive and provident foresight. After stating his philosophy of this problem, Mr. Kennedy explains how national and state planning surveys have given the necessary data on which long-range highway development can be based. This stimulating paper has been condensed from his presentation before the session on "Preparedness for Post-War Conditions" of the Society's Annual Meeting in January.

THE nation is engaged in a war that can end in no other way than in making certain our national existence. It can have no other purpose than to enable us to proceed, after its conclusion, with the normal pursuits of a civilized people. In the post-war era, public works will occupy no insignificant place among those civilized pursuits. For they will form the foundation on which the rebuilding and reconstruction of the post-war world will rest.

Some idea of the size of the task can be obtained from a comparison of conditions obtaining in the previous World War with those in the present one. The economic level preceding the last war, indexed by production, was near 20 billion dollars annually. Following the war, the level was estimated to be in the vicinity of 60 billions, and the peak attained in 1929 approached 90 billions. Everyone knows of the suffering and disaster caused by the shrinkage from this peak during the 1930's. Everyone also is aware that the peacetime application of new technologies and expanded production capacities which are forced by war necessities, results in definitely higher standards of living.

The present effort is also expanding technologies and production capacities. It is opening the way to standards of living appropriate to the higher economic level which not only is expected to obtain but which must obtain in the post-war era lying ahead.

Obviously the planning job required to effect the transition from a war economy to a peace economy, and thereafter to build and rebuild, imposes a tremendous responsibility on, and a challenge to, the engineering profession. The engineer is equipped in his techniques for the job, as witness the engineering effort to build for the war. He can with equal facility build for peace. He will have to equip himself for the post-war job, however, with more than the bare bones of engineering facts. More than ever, he will have to enlarge his knowledge of the social and economic implications of his work.

The purpose of this paper is to present the status of the master plan for the development of the highway system of the United States which will guide post-war highway construction. Unquestionably, highways will have an important part in the post-war program as they did in the emergency program during the depression. But the real justification for the prominence of highway construction is that highways are essential to the orderly functioning of civilized life.

The first and foremost concept which is to be adopted in the derivation of the master plan for highway development is that highways are an integral part of transportation. It is this assumption that permits us to examine our highway transportation system, note its present status, determine its proper place in transportation, list its inadequacies, set the standards to which it is to be modernized, and, in the form of a master plan, decide what we want it to be.

Recognizing that the barest highway engineering facts such as location data, handbook design data, knowledge of materials, and the like, were not enough to develop the highway transport system in the United States, the Bureau of Public Roads (now the Public Roads Administration) undertook a Highway Planning Survey. This was probably the most comprehensive planning project ever undertaken for the development of a nationwide transportation system. It has been prosecuted vigorously since its inception in 1935. The survey is now continuing in each of the 48 states as an established planning function of the state departments and of the Public Roads Administration.

Under the direction of Thomas H. MacDonald, Commissioner of Public Roads, that long and continued planning effort is able to present a master plan for the development of highways in the United States. The surveys have gone far beyond the original outline of minimum facts considered necessary to plan the nation's highways. They encompass more and more the circumstances affecting land uses, population settlement, industrial activity, and other social and economic factors, and planning activities in other fields.

The elements of the master plan for the development of the highway systems are as follows:

1. National inter-regional system
2. State primary systems
3. Secondary systems
4. Urban thoroughfare systems
5. Land-access roads and residential streets

It is appropriate to report briefly on the status of plans in each of these four major systems.

Strictly Scheduled Operations of Industry Impose Sudden Strains on Urban Streets

IMPORTANT MICHIGAN PRIMARY HIGHWAY SERVES DUAL PURPOSE OF TRANSPORTATION AND RECREATION—CRYSTAL LAKE, NEAR LAKE MICHIGAN

The National Inter-Regional System of highways was indirectly an outgrowth of the depression. It originated specifically in a widely voiced proposal for a system of transcontinental routes to be financed from tolls. Congress heeded this demand by including in the Federal Highway Act of 1938 a direction to the Chief of the Bureau of Public Roads that the feasibility of such a system be studied and reported upon not later than February 1, 1939.

In answer to this request of Congress the notable report, "Toll Roads and Free Roads," was produced by the Bureau. The feasibility of transcontinental toll routes was not sustained, but the report presented a "Master Plan for Free Highway Development" which was designated as a "National System of Inter-Regional Highways." The report pointed out particularly that a great need existed for traffic relief in, through, and around our cities and for connections between our centers of population—inter-regional routes.

The importance of this work, particularly in its relationship to public works, was recognized by the President. This recognition consisted in the creation of an Inter-Regional Highway Commission to give further study to the plan and to advance its accomplishment. The writer was appointed a member of that commission, which is under the chairmanship of Thomas H. MacDonald. The work of this committee is going forward vigorously.

It is hoped that laying down the Master Plan for the inter-regional system will provide the framework upon which the integration of the other elements of the nation's system of highway transportation facilities can be based. The prospective reservoir of public works may be visualized from a tentative estimate of cost of the inter-regional system, which amounts to 5.1 billion dollars. Good policy dictates the translation of plans into projects as rapidly as possible.

The State Primary System comprises the state highways which are considered of next importance to the inter-regional highways in each of the states. It should be clearly understood that, in this discussion, the systems of highways under the administration of the state highway departments may contain roads classified functionally as inter-regional, state primary, and secondary, and in some states as land access highways.

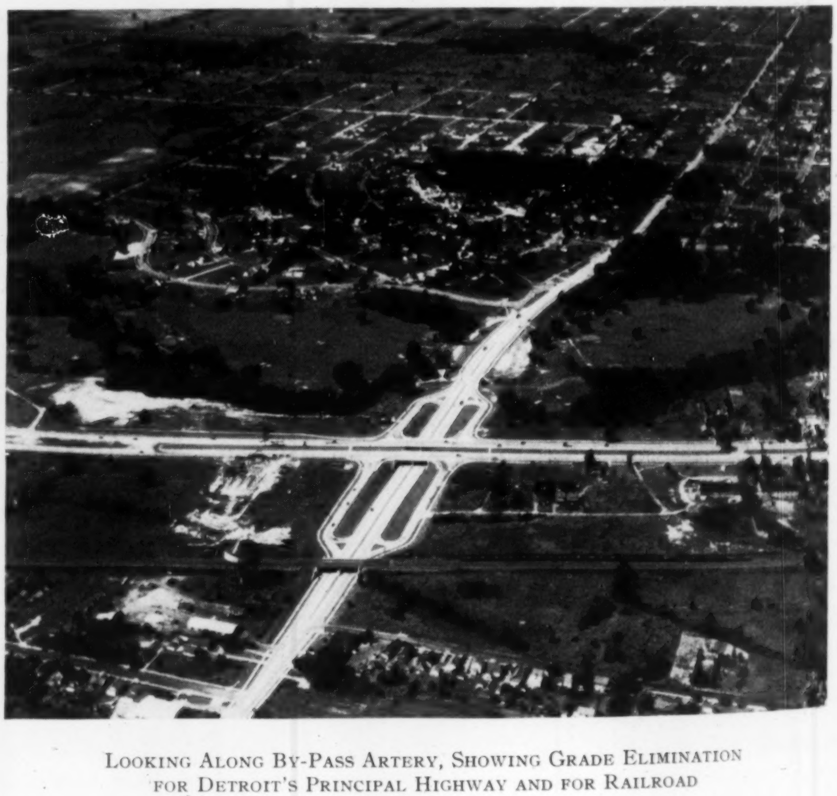
As an example, the Michigan State Trunkline System contains 9,363 miles of rural and urban routes. The functional classification of the state-administered system is as follows: inter-regional, 885 miles, or 9%; state primary, 5,813 miles, or 62%; and secondary, 2,765 miles, or 29%.

PROGRAM TECHNIQUES FOLLOWED IN MICHIGAN

For the purpose of focusing this discussion on the public works possibilities in the development of highway transportation, a brief examination of the needs of a state-administered system seems appropriate. A brief description of the program techniques in Michigan, therefore, is presented. No doubt similar procedures are going forward in other states.

In Michigan, as in the other states, highway administrators have noted accumulated inadequacies on the systems under their charge. But precise and detailed knowledge was not available to them. It was not available, first, because an accurate current inventory of the physical highway plant was lacking, and second, because the facts necessary for the establishment of ultimate standards on individual sections of the systems were not available.

Planning surveys supplied these lacks. With the intelligent collection of information, and its interpretation and application, a sound engineering appraisal of needs has been obtained—the first step in highway programming. The expression of those needs in terms of ultimate standards of design, which meet the broader requirements of functional classification, constitutes the master plan for developing the state-administered system. The design standards adopted represent the combined experience and research efforts of the states and the Public Roads Administration. They are gradually being recorded in the policy manuals of the American Association of State Highway Officials.



LOOKING ALONG BY-PASS ARTERY, SHOWING GRADE ELIMINATION FOR DETROIT'S PRINCIPAL HIGHWAY AND FOR RAILROAD

The Master Plan of the Michigan State Highway System, projected to the decade of the 1960's, may be summarized as follows:

Multi-lane high-type classification	2,591 miles
Two-lane high-type classification	3,766 miles
Two-lane intermediate classification	3,050 miles
Total planned system	9,407 miles

This plan sets the goal, as present knowledge permits. In Michigan we are translating this master plan into actual projects to be prosecuted as a part of the public works highway program. The master plan described covers the major portion of the system which is to meet the highway transportation requirements of the state of Michigan. The plan brings together the functional requirements and the physical needs of the system. The rate of attaining the goal in building the system is contingent on the financial resources available year by year and the pressing demands for service. When demands are imperative, the financial resources available are increased; when demands decrease, financial resources are likely to be diminished.

Official recognition of the need for a functional secondary system on a national scale was given in the Federal Highway Act of 1936. The Public Roads Administration thereafter reduced the intent of the legislature to administrative regulations, the essence of which was to determine a functional secondary system of highways to be integrated with the planned systems of higher order in the transportation network. The regulations provided that the system was to be selected from the three million miles of rural highways in the nation.

The possibilities of utilizing the secondary system in public works planning are great, for this system is a vital part of the immensely important rural rehabilitation and land-use readjustment work which will be undertaken in the post-war period. Hence, responsible agencies should begin at once to prepare construction projects on those sections of the secondary systems which have been definitely classified.

IMPORTANCE OF INTEGRATION WITH URBAN NETWORK

Integration of the transportation network with urban communities presents a most important phase, if not the most important phase, of highway planning and post-war construction. The inter-regional system, the state primary system, and the secondary system pierce the peripheries of urban areas and form parts of the city street transportation system. It becomes imperative, therefore, that plans for the entire city, its immediate environs, and the larger region of which the urban center is a vital part, be considered in relation to the highway plan.

Planners have been conscious of the gradual breakdown of large urban centers as functioning social and economic organisms, and they realize that much rehabilitation and reconstruction will be necessary to restore these centers to a better status. The job in many fundamental aspects is similar to that of restoring land to productive use in the cut-over forest areas of the nation. It is not within the scope of this article to describe the ills that beset our large urban areas or to describe, if it were possible, their ultimate planned future. Suffice it to say that no more fertile field for post-war work is to be found.

In the field of transportation, it can be said that the most acute traffic congestion is to be found in the larger cities and metropolitan areas. This situation can only be relieved by providing modern street facilities as basic parts of the replanned community.

Widened Radiating Street Permits Freer Access to Detroit's Central Business District

The Michigan State Highway Department has conducted intensive studies of the traffic situation in Detroit (*Street Traffic*, City of Detroit, Mich., State Highway Department, 1937). This study has gone far beyond the concept of the ordinary traffic survey and includes many social and economic factors which will aid in the replanning of that metropolis. Since the original survey, studies have been continued as part of the department's planning program. Now under way is a study of transportation of materials and workmen in relation to war production plants, and the relationships of water and rail transportation to highway transportation.

DETROIT SURVEY YIELDS VALUABLE FINDINGS

Significant among the findings is the fact that 80% of the working population is dependent on private automobile transportation. By contrast, 70% of the persons who daily visit the downtown district depend on mass transportation facilities, many on motor buses. This is startling information. The mass production center of the nation is almost solely dependent on the motor vehicle for transportation. Furthermore, a tremendous part of Detroit's industrial labor reservoir is in the area immediately surrounding the central district—the area of most serious blight. The location of this heavily populated area in relation to the principal industrial centers which employ these people is such that crosstown movement and downtown movement are in perpetual conflict.

The Department's knowledge of these and many other conditions has enabled it to integrate inter-regional city terminal treatment with intra-city conditions. As a result, a very considerable beginning has already been made in the preparation of projects of major importance for the post-war public works program. Similar considerations have enabled the Department to lay out a tentative plan of motorways for the area (*A Comprehensive Plan of Motorways for Detroit*, Michigan State Highway Department, 1941).

City planning activities in the nation, and hence street planning for individual cities, must be advanced to insure the productive value of public works in this vital field. However, planning in most cities has already progressed to a point where the designs and specifications for many specific projects can and should be made ready for

THIS 8-LANE DIVIDED ROADWAY OUTSIDE DETROIT SERVES 27,000 OR MORE VEHICLES A DAY, UP TO 60,000 PEOPLE

construction. There is often real danger that this step will be unduly delayed by too great insistence on completeness of planning data and ideal planning procedures.

Although local roads and streets have little transportation significance, they do have a place in land rehabilitation programs in rural areas and in rebuilding programs in cities. This segment of the roadway network is more appropriately a part of local rebuilding projects than of the large-scale highway program.

THE PROBLEMS OF FINANCE

The financial implication of this program is the most complicated phase of the post-war effort. Financing is of fundamental importance in the rate of accomplishment of the work. The soundest guide to financing any public capital outlay program is to consider the annual installment of physical construction which is within the budgetary abilities of the units responsible for the consummation of the project.

It may be appropriate to mention one financial aspect of the highway transportation system. At present rates of collection, during the next twenty-five years approximately 35 billion dollars will be collected from highway users. The careful expenditure on highways of the full amount collected would do much to improve the system, even allowing for maintenance, debt service, and other charges. It is hoped, of course, that federal work relief funds will supplement these revenues during the post-war transition period.

It is impossible to relate local units to the transportation plan outlined, because the expenditure of funds by them is largely directed to the improvement of land access roads and streets. But the sums contributed annually for the support of those local roads are large. Between 1933 and 1939, local units received from federal relief sources 14.5 billions of dollars for all public works, of which a substantial sum was for highways.

Michigan's highway planning studies reveal that this emergency aid resulted in a corresponding reduction in locally raised revenues for this purpose. In other words, assumption of financial support for local highway and street services by the federal government has developed as an accompaniment of its program of unemployment relief. This in reality constitutes a change in road taxation policy. Responsibility for tax collection tends to drift from lower to higher levels of government, and this trend is characteristic of state as well as of local units. This situation raises complicated questions in public finance, which ultimately must be answered.

One can only speculate on the changes in governmental fiscal policy which are being wrought by the prosecution of the war. The concentration of all productive effort on the non-productive implements of war is, from an economic viewpoint, calamitous, though the preservation of our national security will be well worth the cost. But the salvation of the post-war period will depend upon how quickly our capacities can be converted to wealth-producing activities.

POST-WAR PROGRAM MUST BE PUT ON SOUND BASIS

The post-war program for maintaining the high wartime levels of national production will permit the more rapid realization of plans of public works. But if the transition to peacetime economy is to be sound, the program must produce works which actually contribute to the effectiveness of our basic economic and social equipment. Hence it is of paramount importance that plans be prepared on a sound basis.

An attempt has been made to give a brief picture of the status of highway planning in the United States. But planning is only a preliminary to accomplishment. It is an essential step in obtaining optimum results, but it is no substitute for getting the job done. The engineer's primary responsibility in relation to the post-war public works program is to get projects ready to be put under construction when the time comes.

In selecting those portions of our plans to put into complete project form, it is necessary to judge their relative desirability carefully and accurately. But it is not necessary, nor will it be wise, to be niggardly as to their number or the volume of work they represent. Experience in the past and the best estimates for the future, point to two years as the minimum period which the projected public works program will have to meet heavy demands for emergency employment and business stimulation.

MODERN OFFICE BUILDINGS IN DETROIT, WHICH CONCENTRATE PASSENGERS AND FORM FOCI OF HEAVY TRAFFIC MOVEMENTS

The same sources of information forecast that about two years will elapse before the end of the war will require that this program swing into action. The next two years, then, is the period available for scanning our plans and converting them into complete projects ready for contractors to figure on. It is only by thorough preparation that we can realize a tolerable proportion of the potential benefits of a post-war public works program. The problem of ultimate highway development is a huge one and the formulation of sound engineering principles to govern it will be of lasting value.

Importance of Surveys and Maps in Public Work Programs

By Murray Y. Poling

Director, Engineering Surveys Section, Work Projects Administration, Washington, D.C.

Surveys and maps are essential to long-range planning of public works. This fact justifies initiating a broad program that will provide adequate information on which to base the construction of capital improvements in the post-war period. Types and uses of such surveys are briefly reviewed in this article. Then follows a brief statement of the part the WPA has played in this valuable engineering work since 1935.

Effective use of the essential implements of modern warfare depends, to a large extent, upon survey and map information for defensive and offensive operations. Such information is used for reconnaissance and combat purposes and is invaluable when making repairs and replacements after combat operations have ceased.

The need for accurate survey and map information has been made more apparent in cities that have experienced damage from air raids or shell fire. In order to prevent destruction of life and property from fire or other cause, it is essential to know accurately the locations of important surface structures, water and gas lines, electric conduits and power lines, and communication lines, including their surface outlets and service connections. The Work Projects Administration has emphasized the importance of survey and map information through the assistance given sponsors for the operation of engineering survey projects. Since war was declared, the value of such information has increased tremendously.

During the past eight years, the primary purposes of public work programs aided by federal funds have been to provide jobs for those in need, to assist in stimulating business and stabilizing industry, and generally to improve conditions in order to plan for better living conditions and retain our traditional liberties. It was essential during this period to provide jobs, on comparatively short notice, for millions of unemployed persons. Hence it was necessary to initiate projects for constructing capital improvements because they utilize large numbers of workers skilled and unskilled. It is these worker groups that represent the largest percentage of persons to be employed in normal times as well as during economic depressions.

SURVEYS TO BE CONSIDERED NOW

There is every indication that the post-war period will place even increased reliance upon public work. If this be true, then it will be necessary to expand the construction of capital improvements beyond the peak reached in the federal work programs since 1933. It is important, therefore, to determine the basic factors that should control a broad construction program. Under such a program, the primary factors are not necessarily the availability of materials, supplies, and personnel, the types of design and cost of structures, or the number of persons to be employed. Although these items are important, first consideration should be given to actual factual information, to determine whether the improvement should be made, its proper geographical location, its relation to a well-organized plan, and whether its ultimate value justifies the expenditure. The securing of such information, based on physical aspects as well as on relatively intangible values, provides the only economic approach to the planning and construction of capital improvements. This emphasizes the value of a long-range program of surveys and maps in any type of program executed by local and state governmental agencies or by federal-aid funds.

Many studies, surveys, and certain types of maps appear to officials having the responsibility of carrying on the public business as intangibles not warranting serious consideration, except as needed to satisfy piecemeal or emergency construction activities. Perhaps they justify this attitude by pointing to the unfavorable financial status of the community, but the true reason for it is probably a desire to secure credit for the current local regime by constructing projects that are outwardly more impressive.

The necessary studies and surveys are given too little credit for their long-range value. In some instances, the local survey programs consist of only the physical items affecting the specific structures proposed, with little bearing on the community plan. In others, the physical information is inadequate for either purpose. Although the need for this preliminary information may be conceded, actual preparation of a well-ordered local plan is not generally given appropriate consideration until after the community has expanded beyond the existing facilities. Then the cry is "Something must be done!"

© Massachusetts WPA

Chaining Party on Second Order Traverse

MAKING CONTACT AT FRONT END OF TAPE DURING MEASUREMENT OF FIRST-ORDER BASE LINE FOR TRIANGULATION

The date on which the inevitable post-war period will begin is beyond the power of any individual to predict. The time to prepare is in the interim preceding it. That time is here. In order to be prepared for an extensive public works program, in which the major operation will be construction, full advantage should be taken of this intervening time by compiling data, executing surveys, preparing general plans, making preliminary estimates, and recommending priorities of construction.

As a result of the past and current work programs, the need for basic information has been accentuated. In many areas the compilation of invaluable data has been completed or is under way. However the information available at the present time is believed to be inadequate for the operation of a program of sufficient magnitude to satisfy post-war employment needs.

LONG-RANGE PLANNING

Volumes full of information on planning and its various phases have been published. Yet in spite of all these valuable recommendations, there are few instances where the necessary data have been collected and used for planning orderly, long-range programs. To produce a well-organized plan, accurate information must first be obtained through surveys, studies, and maps relating to the physical, social, economic, financial, and cultural phases of the public works to be executed.

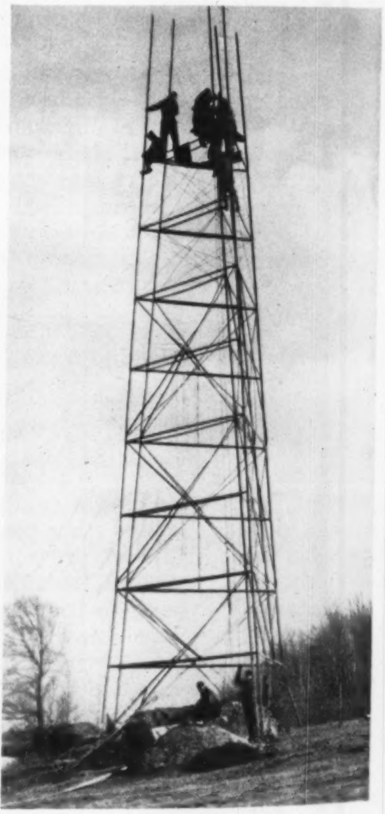
Although each of these elements is a part of the master plan and is important in long-range planning, only items of a physical nature are being proposed for consideration, as this information is used as the primary basis for plans and estimates. Maps afford a means for plotting the various statistical and research data in addition to existing physical characteristics.

Broad practical experience has been gained in executing surveys and preparing maps under the WPA. Based on this experience, a list of survey and mapping activities is included here to show what is needed in a long-range program. The sequence of operations is highly important. Although local conditions and information already available may require a deviation from this order, there should be no fundamental change, especially in regard to the first four items.

SURVEY, STUDY, AND MAPPING ACTIVITIES

1. Geodetic control surveys
    a. Triangulation
    b. Traverse
    c. Levels
2. Topographic surveys and maps
3. Restoring and monumenting boundaries
    a. Section and public land lines
    b. Urban
    c. Highway, road, and street
    d. Block and lot
4. Underground and surface utility structures surveys
5. Wall or base map
6. Property identification and tax maps
7. Land-use maps
8. Geologic surveys
    a. Bedrock surfaces
    b. Stratigraphy
    c. Resources
9. Soil surveys
10. Cross sections and profiles
11. Surveys and plans of existing public buildings
12. Traffic surveys and studies
13. Transit and transportation studies
    a. Facilities and uses
    b. Special features
14. Riparian, stream, and hydrographic surveys and charts
15. Climatologic and meteorologic studies
16. Natural resources

No procedure can be considered as an absolute standard. However, the preceding sequence should be followed without great variation if an economic approach is to be made to the over-all problem. Basic surveys should be executed first. Otherwise, the operation is comparable to replacing the foundation of a newly constructed building because the original one is inadequate or poorly designed. Although such a procedure would be considered to indicate a grave error in the original design, such practices for surveys have been going on year after year in many large cities. Hence the four major items of the survey and map foundation program are emphasized because such work is of basic importance to planning and operation.



ERECTING STEEL TOWER FOR TRIANGULATION OBSERVATIONS

GEODETIC CONTROL

The framework on which surveys and maps are based consists of horizontal and vertical controls. These may be executed by approximate horizontal measurements to physical objects and the use of assumed elevations to serve a temporary need, or they may be executed as a control system or network subject to mathematical adjustments which ensure consistent accuracies throughout the entire area and establish permanent data for all survey purposes. As the control and the office and field procedure are standardized, such operations should not vary widely because of local circumstances or the opinions of individuals who may profess to know what is ultimately needed, but who are not familiar with the procedure for obtaining the desired results.

Most engineering survey problems in urban areas are not confined to a single street or block, but affect an entire area. The determining of a street boundary, for instance, may appear to be merely establishing the boundary itself. However, such a survey usually affects other street boundaries and may revise the boundaries of private property. The basic system for control is the geodetic survey, which consists of triangulation, traverse, and levels. The need for such basic surveys for national defense, as well as for normal planning activities, is generally recognized. The work should be executed in advance of a post-war public works program if possible; otherwise operations should be prosecuted as one of the first steps in the post-war period.

The next step in the operating sequence is the execution of topographic surveys and maps. These may be called the primary base maps, as the information portrayed deals with the characteristics of the terrain itself, as well as all structures to be built. This type of map may be prepared for an area of any size up to an entire state or region. Depending upon the size of the area, topographic maps differ in scale, contour interval, mapping methods, and the purposes they serve. Small-scale maps of large areas may be used as general-purpose maps to determine drainage areas, forest coverage, reconnaissance uses, military or naval tactics, soil classification, land use, and regional zoning. Large-scale maps covering comparatively small areas may be used for detailed planning and zoning.

RESTORING AND MONUMENTING BOUNDARIES

Accurate determination of the positions of property and land boundaries and the restoration of boundary markers constitute one of the most important phases of the survey program. Field surveys are the basis upon which the legal descriptions of property are prepared; therefore the results of such surveys should be preserved both in the field and in the public record. Millions of dollars are expended annually in this country on litigation over property boundaries because surveys were originally performed carelessly or were not tied into an accurate coordinated survey so as to preserve the field locations of the original markers.

Restoration and monumenting of boundaries should not be executed by obsolete or inaccurate methods. In some areas, property increases in value over short periods of time so that the original measurements cease to be sufficiently accurate. The legal descriptions of the property may not be held valid irrespective of lines of occupation or apparent errors between boundary markers. If the original markers are restored and the actual distances between them do not agree with the figures in the original description, the original distances are usually declared invalid. However, in order to preserve the legal locations both in the field and in the public record, a boundary survey should be tied into the basic horizontal control. Through the use of coordinated positions established by such basic control, the boundary survey not only will be facilitated, but will assure a permanence and value not otherwise possible.

Triangulation Signal Light, State of Washington

Observing Angles on a Second-Order Traverse

To continue piecemeal boundary surveys merely to satisfy temporary needs is postponing the day when it will be necessary to make a comprehensive survey of the entire area. This delay therefore does not appear to be consistent with orderly planning; it necessitates the making of unrelated surveys and resurveys which often result in costly litigation and other increased expenditures.

Although the restoration and monumenting of property boundaries is of sufficient importance and magnitude to be considered as a major phase of engineering surveys, it appears to be more appropriate to think of it merely as putting into practice the accurate horizontal controls established by the geodetic survey. The amount of work to be done in this field is practically unlimited, considering that state, county, township, section, highway, road, street, block, and other public boundary lines are affected.

UNDERGROUND AND SURFACE UTILITIES

Although the value of maintaining accurate records of underground and related surface utility structures is recognized, the pertinent surveys and records in many urban areas have been neglected for years. These are highly important as they affect the construction and maintenance of capital improvements and include items that relate to the life and health of any community. Such items include the furnishing of up-to-date information on the horizontal and vertical locations, size, type, condition, and other physical characteristics of water, sewer, gas, steam, power, telephone and telegraph lines, police and fire-alarm systems, and their surface outlets and service connections; bridges, culverts, tunnels,

COMPARING STEEL TAPE WITH 100-FT STANDARD LENGTH

mines, and underground vaults; and the physical characteristics of street, road, and walk paving.

This type of work represents another major use that should be made of the horizontal and vertical control established by a geodetic survey. Large-scale maps should be prepared, which may range in scale from 1 in. = 10 to 100 ft in urban areas, and from 1 in. = 200 or 400 ft in county-wide areas, depending upon the density of structures. All scales larger than 1 in. = 200 ft should be divisible into 200, such as 10, 20, 40, 50, and 100. In some instances where a standard topographic map has been completed, the composite map sheets showing utilities may be given a unit or section number which will correspond to the appropriate section of the topographic sheet.

The work should be performed over the entire area involved, rather than confined to serving the immediate needs of a specific construction operation.

It has been, and still is, the policy of the WPA to have its survey and map work conform to the best engineering practice resulting from the standards established by professional societies and recommended by federal agencies with years of experience. Although sponsors of projects have cooperated by giving more consideration to the importance of map scales and to modern methods of executing engineering surveys, their opinions on what is needed and how the work should be executed are often based upon types of surveys previously executed or on the nature of the maps in need of revision. Perhaps there is some justification for revising old odd-scale maps or for continuing the same type of surveys previously executed when such work is entirely dependent upon the appropriation of local funds. Frequently such funds are insufficient to execute a comprehensive survey or mapping program. However, when federal funds are available, every consideration should be given to the long-range value and the best engineering practices which will satisfy current problems, as well as meet future planning needs.

The Work Projects Administration has assisted in the execution of surveys, the preparation of maps, and the collection of information for plotting on existing maps. From 1935 through 1940 it has expended almost $62,000,000 of federal funds on 3,746 survey projects.

This amount is significant because it is comparable to the combined expenditures of the major survey and mapping agencies of the Federal Government.

In the four major groups of fundamental surveys there were 2,870 projects requiring $56,000,000, or 76.6% of the projects and 90.5% of the funds. Results of some of the city surveys are given in Table I.

OBSERVATION TOWER FOR TRIANGULATION, SUPERIOR, WIS.

FUTURE PROGRAMS

If the value of survey and map information is given consideration proportionate to the actual and potential needs of the nation, it is obvious that such work will be carried on with all possible speed. During the present emergency, this information is invaluable for use in military, naval, and air operations, in the protection of life and health, and in determining the location and extent of the nation's resources.

With regard to future public work programs, survey and map information is essential as a basis on which to plan an orderly development and readjustment in the post-war period. It is only with the aid of such information that an economic approach can be made to efficient planning and construction of capital improvements.

TABLE I. TECHNICAL RESULTS OF VARIOUS TRIANGULATION PROJECTS IN URBAN AREAS UNDER WPA

CITY	RESULTS FROM FIELD OBSERVING				PROBABLE ERROR OF MEASURED BASES	FINAL RESULTS FROM LEAST SQUARES ADJUSTMENT		
	Triangle Closures		Side-to-Side Discrepancies					
	Av. (Sec.)	Max. (Sec.)	Av. (Sec.)	Max. (Sec.)		Base-to-base Discrepancy	Average Correction to a Direction (Sec.)	Probable Error of an Observed Direction (Sec.)
Cleveland, Ohio	1.59	3.76	..	..	1:2,006,000 2,150,000 1,300,000 1,489,000	1:93,000	0.54	0.70
Boston, Mass.	1.22	3.21	0.48	1.65	1:1,638,000 643,000 1,862,000 2,051,000 2,234,000	....	..	..
Bridgeport, Conn.	1.31	2.94	0.64	2.13	1:1,678,000 2,484,000 3,853,000	1:3,378,000	0.54	0.64
Minneapolis, Minn.	1.08	3.36	0.59	1.83	1:1,657,000 3,246,000 and one fixed federal length	....	..	..
Superior, Wis.	1.09	2.50	0.49	1.60	1:1,850,000 894,000 978,000	1:378,500	0.49	0.59
Worcester, Mass.	0.85	2.54	0.28	0.95	1:1,554,000 1,639,000 3,695,000	....	..	

The Design of Airport Paving from the Soil Mechanics Viewpoint

With Special Attention to Subgrade and Base Courses

By T. A. Middlebrooks, Assoc. M. Am. Soc. C.E. *and* G. E. Bertram

Respectively Principal Engineer and Engineer, Corps of Engineers, U.S. Army, Washington, D.C.

Air power is still the key to success in modern warfare because supremacy on land or sea must be accompanied by supremacy in the air. Air power cannot function without landing facilities and therein lies the importance of the aircraft carrier on water and the airport on land. An important phase of airport construction is the runways, which are the subject of this paper. Too often they are dismissed as merely an extension of highway construction. In many ways they resemble highways but in other important respects they are very different. The authors here explain the various soil features which must be considered in the design of runways.

Under the conditions of national defense construction, the structural design of airport runways, as distinguished from layout, has become a problem of increasing importance. At first glance it would appear that these structural elements are duplicated in highway work and that proved designs could be carried over directly from one field to another. In a limited sense this is true. Construction practices are the same, but there is an important distinction in design loads. Maximum static highway wheel loads are in the neighborhood of 8,000 lb; maximum static airplane wheel loads are approximately 80,000 lb for the new B-19 bomber. While it is recognized that this may be considered an unusual load, inasmuch as only one of this type has been built, heavy bombers have static wheel loads of 25,000 to 60,000 lb. When the magnitude of the loads and the area of tire contact are considered, the impossibility of extrapolating present design practice to cover such limits becomes obvious.

Airport runways can be subdivided into two general groups based on the characteristics of the pavement in transmitting wheel loads to the subgrade. These are the rigid and flexible types of pavement. With the rigid type, the pavement is considered to act as a beam of sufficient strength to bridge inequalities in the subgrade. In the case of the flexible type, however, subgrade resistance is depended upon to prevent detrimental deformation. In both cases, the design and construction procedure is subdivided into subgrade, base courses, and surfacing.

The major factor in the design of any pavement is the material in the subgrade. This is especially true of flexible surfacing, but it is also of prime importance in designing concrete pavements. The ideal subgrade material is one having satisfactory inherent stability which does not change with a change in moisture, does not expand, and is non-frost-heaving. In the construction of most air fields it is possible to schedule the grading operations so that the best material can form the subgrade for the pavement. In a large number of cases this select material will form a satisfactory subbase or base by itself. In other cases, it need be mixed with only a small amount of satisfactory material from outside sources to secure the desired results. There are numerous cases, however, where all the subbase and base material must be hauled in from outside. Usually it will be found more economical to haul in all the base material than to attempt mixing with the natural material. Compaction of the prepared subgrade to maximum practical density with rolling equipment is essential for all types of subgrades and base courses.

Swelling or shrinkage of the base or subgrade material is undesirable since it will promote non-uniform bearing and differential movement of the surfacing. If water is kept out of the subgrade, swelling will not occur. Present means of preventing this infiltration through the joints and cracks of concrete pavements cannot be entirely relied upon; therefore any natural subgrade material which shows decided swelling characteristics must be treated to make it non-expanding, or non-expanding material should be placed over the natural soil to form a satisfactory subgrade.

Two of the most common methods of treating the natural subgrade are to compact it at the moisture content and density that will minimize expansion, or by the addition of a coarse aggregate or granular soil, to form a mixture which will in itself be non-expanding. Expansion tests are required in the application of both methods—in the one case to arrive at the correct moisture and density for compaction, and in the other to find the amount of admixture necessary to make the natural soil non-expansive. Field control of the compaction method must be carefully exercised, since if the soil is compacted too dry, the expansion will increase, and if it is too wet, low densities will be obtained and the material will shrink during a dry period and expand during a wet one. The placing of a non-expanding material over the natural soil is of course the most reliable means of solving this problem, and it is employed wherever it is economically feasible.

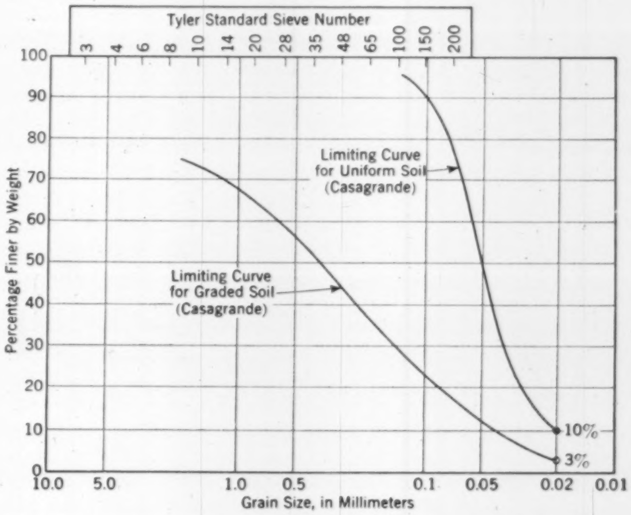
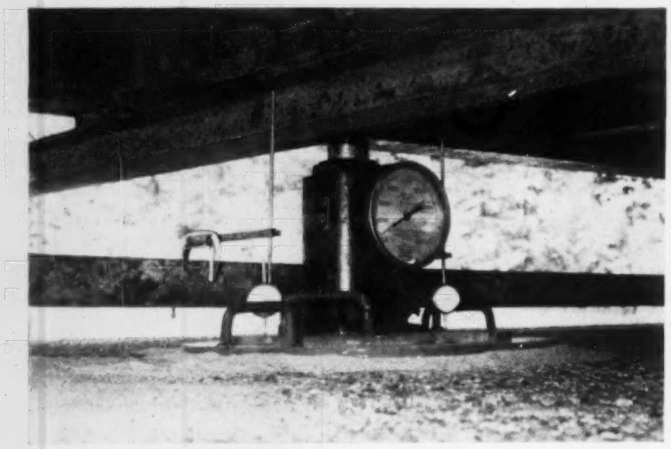


Fig. 1. Limiting Curves Between Frost-Heaving and Non-Frost-Heaving Soils (After Casagrande)



LOAD IS APPLIED TO THE SURFACE THROUGH CALIBRATED HYDRAULIC JACKS

Frost heaving is another important item that must be carefully studied in the design of pavements. Its effect on the pavement itself is quite similar to swelling of the base or subgrade, except that the differential movement is greater and the resulting decrease in bearing due to entrapped water causes more damage to the pavement. The most generally accepted method for the prevention of frost heaving is the placement of a non-frost-heaving material over or in place of the natural soil. In some cases, drainage might be utilized to lower the ground water sufficiently to prevent frost boils; however in most cases drainage is only used to release trapped water from coarse pockets. The possibility of using a layer of insulating material or of chemically treating the subgrade under the pavement may prove satisfactory, but these methods have not yet been thoroughly explored. Limits of potential frost heaving soils are shown in Fig. 1. The availability of water, as well as the temperature gradient and other local conditions, are controlling factors in determining whether a particular soil will actually cause trouble. In tight clays, frost heaving is not a major problem since the forces are not great enough to cause migration of water through the small voids.

Runway drainage has a twofold purpose—to remove surface runoff with the minimum of interruption to normal traffic, and to assist in providing a stable subgrade under all conditions of weather. To accomplish these aims, drainage systems are provided. The design of storm drains is based on existing hydrological conditions and the topography of the airfield, while the design of subdrains is dependent on the permeability of the subsoil and the location of the ground-water table. Only a relatively few soils can be successfully drained by subdrainage systems, and accordingly pavement design is based on the consideration of a saturated subgrade whether this occurs by capillarity or condensation of moisture under the pavement. The allowable grades of runway pavements are so flat that drainage is often impracticable even in granular base-course materials unless they are uniformly graded sands or gravels.

In all cases, the drainage systems should be separate in order to prevent the saturation of base-course materials due to storage during storm periods. The relationship between the grading of the adjacent soil and the filter material, for both uniform and well-graded foundation soils, is indicated in Fig. 2.

FACTORS GOVERNING THICKNESS OF BASE COURSE

The thickness of the base course necessary to give the required bearing power for rigid or flexible pavements varies with the supporting power of the subgrade. There are numerous formulas and methods for determining this thickness using subgrade resistance, but it is generally agreed that they give only a rough approximation. These formulas were developed for highway loads, which are relatively light compared with present and possible future plane loads. The unit loads in pounds per square inch on the paving are approximately the same for highways as for air fields, but in the case of air fields the total load is greater and extends over a larger area. The effect of this is twofold: (1) the maximum pressure differential (Fig. 3) is forced deeper into the subgrade, and (2) all subgrade pressures are proportionately increased. The thickness of the base course required to give proper support to the surface course can be accurately determined by constructing test sections having different thicknesses and subjecting them to field bearing tests. Such tests should be performed with loads and areas comparable to those of the planes to be used on the field. The cost of these test sections is small compared with the total cost of the job, and their construction and testing need not delay the preparation of plans and specifications, or advertisement, since in most cases the changes will be only in base-course thickness.

Thickness of the base course required to produce a known bearing capacity can be roughly approximated from the principles presented by Charles Lelievre and A. Pons in their paper, "Construction of Waterbound Macadamized Roads" (Third International Road Congress, London, 1913). Another empirical method which has proved satisfactory on highways, and which shows

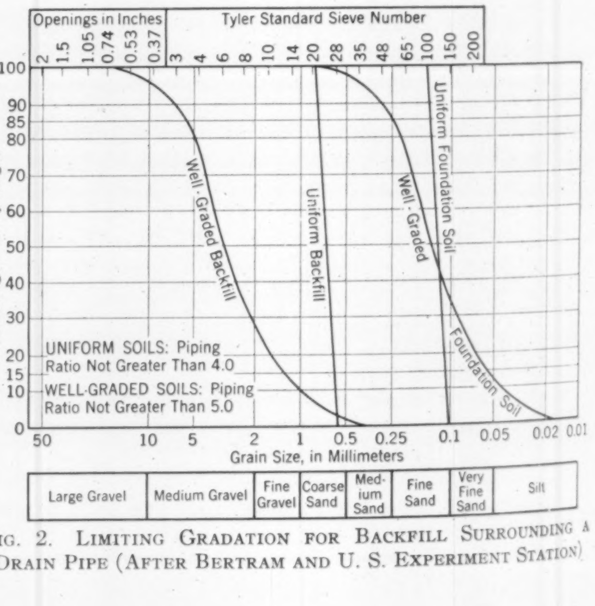


FIG. 2. LIMITING GRADATION FOR BACKFILL SURROUNDING A DRAIN PIPE (AFTER BERTRAM AND U. S. EXPERIMENT STATION)

Elevating Grader, Caterpillar-Type Tractor, and Pneumatic-Tired Wagons Preparing an Airport Runway Base Course

considerable promise for airfields, is the California bearing test method (*Proceedings* of the Highway Research Board, Part II, 1938).

The required supporting power for the surface course is obtained by several means, such as compaction; stabilization of the natural material with admixtures; construction of a base course of selected natural material over the weak subgrade, or a mechanically stabilized base course of crushed stone, slag, or other suitable aggregate and binder materials; or excavation of weak subgrade and replacement with satisfactory natural material.

At some locations the natural subgrade material (A-1, A-2, and A-3 soils, *Public Roads*, May 1929) is satisfactory, after proper compaction, for a surface course to be placed directly upon it. Glacial sand and gravel, which is usually well graded, is one of the most common natural materials that gives a satisfactory base. Usually these materials are sufficiently well graded to be stable even though little binder is present. Some well-graded river sands and gravels require only a small amount of fine-sand or coarse-silt filler to make them satisfactory.

A mechanically stabilized base is by far the most satisfactory type, since its properties do not change appreciably under weathering. A wide variety of natural material of the A-1, A-2, and A-3 groups, as well as crushed stone and gravel, can be used directly or can be mixed to form a satisfactory base of this type. Although a wide gradation from gravel to coarse silt is desirable, the presence of material above coarse sand is not essential. The main requirements are that it shall be a well-graded, dense material with a sufficiently low liquid limit and plasticity index to insure a stable mass under adverse moisture conditions. The result is a permanently stabilized base, whereas most bases stabilized by an admixture deteriorate with age. In potential frost-heaving areas, the type and percentage of fines should be watched closely to make sure that the base material conforms to the requirements for prevention of this difficulty.

In the absence of suitable local materials to accomplish mechanical stabilization, it is necessary to resort to stabilization with admixtures. Portland cement, cutback asphalts, emulsified asphalts, and tars are used for this purpose. These admixtures may be used to best advantage in relatively sandy or friable soils where pulverization and thorough mixing of the admixture and soil can be readily accomplished. The value of admixtures decreases with increasing clay content because of the additional amount of admixture required and the increased difficulty of operation. With any admixture, thorough pulverization and mixing are essential.

Two main types of surfaces are used on runways—bituminous and concrete. The former are generally similar to those employed for highways and therefore a description of them will not be given here. Because of the attention given to subgrade preparation and base-course construction, bituminous pavements of great thickness are not generally employed.

A bituminous surface course sufficiently thick to resist traffic abrasion and displacement will support any design wheel load when a base of the required bearing is provided. Special requirements of landing and braking dictate the use of dense mixes with a granular but nonabrasive texture. It is generally agreed that for heavy bomber fields the minimum surface course of bituminous pavement should be approximately 3 in., and for light pursuit fields, approximately $1^1/_2$ in.

A rational design method for rigid highway slabs was presented by Westergaard in 1926. The stresses acting in the slab were computed by assuming it to act as a homogeneous, isotropic, elastic solid in equilibrium, the reactions of the subgrade being assumed vertical and proportional to the slab deflections. The problem accordingly became one of applied theory of elasticity. The wheel loads were considered to be uniformly distributed over the area of a small circle. In 1939, Westergaard reexamined his solution for the purpose of determining its applicability to the concrete runways of airports. The only changes he considered necessary were to take into account the larger area of tire contact and the increased wheel loads.

One of the most important variables in the design of concrete pavements is the method of determining the bearing capacity of the subgrade. Base courses under concrete pavements are being used more extensively to provide a higher and more uniform bearing under the slab.

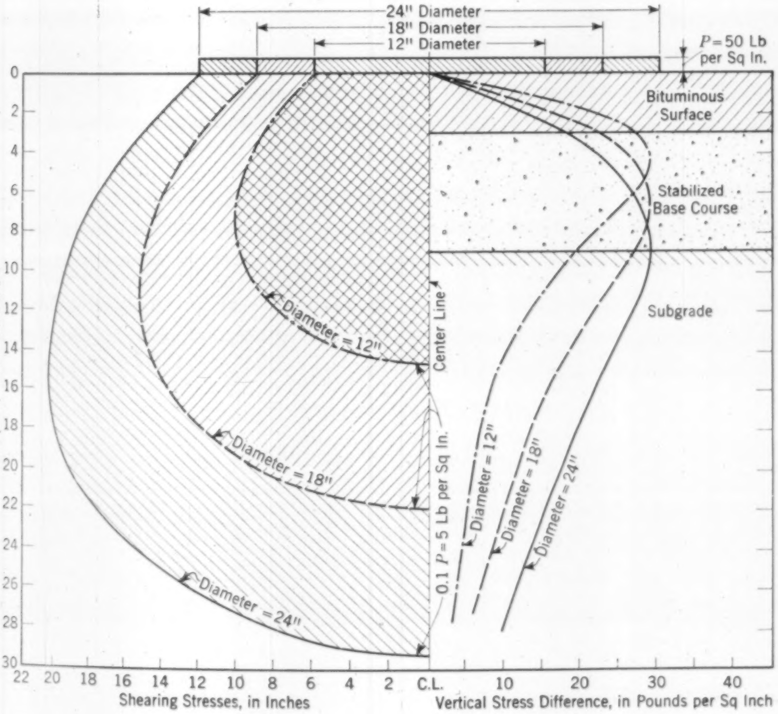


Fig. 3. Effect of Increased Bearing Area on Subsurface Stresses

Placing Asphaltic Concrete Runway on Rolled Trap-Rock Base

Investigations are under way to check the present methods of design as applied to heavier plane loads. There are two main questions to be answered in this investigation: What thickness of pavement will be required for heavier planes, and to what extent can base-course treatment be substituted for increased pavement thickness?

Warping of concrete pavements by upheaval at the joints and cracks is due to swelling and frost heaving in the subgrade and is caused, as previously stated, by the infiltration of water through unsealed openings. Past experience on highways indicates that it is very difficult to seal the joints and cracks to prevent such infiltration. However there are several joint-fillers which appear to be satisfactory although they have a maximum life in the field of only about 5 years. Promising mixtures of this type are an asphaltic-latex mixture which can be prepared in the field, and pure rubber compounds, commercially obtainable. Several of these compounds are very elastic and adhere tenaciously to the concrete. Five years' service on highways has shown that for this period at least a watertight seal is obtained, and the materials retain their elasticity and adherent qualities. Another type of compound which has had several years of satisfactory use on Minnesota highways is made up of about 30% diatomaceous earth and 70% soft asphalt.

IMPORTANCE OF SOIL TESTS

Soil tests for the design and construction of runways are essential. Such tests are made on representative samples taken during a soil survey conducted concurrently with the field survey. The soil survey includes, in addition to data on the soil profile, information on ground-water levels, soil moisture, frost penetration, and the character and availability of various types of borrow materials. Classification tests are made on the subgrade soils which give the density in place, void ratio, grading curves, and plastic (Atterberg) limits. Expansion and shrinkage tests should be run whenever there is a doubt as to the volume-change characteristics of the subgrade material. The design of mechanically stabilized courses is largely based on the combination of grading curves which meet the plastic-limit requirements of the stabilized mixtures. Cement and bituminous stabilization are designed on the basis of tests that have not yet been standardized among the various commercial laboratories. Bituminous admixtures, for example, are tested for stability in an apparatus combining compression and shear in a manner that does not yield direct values of compressive strength. Cement admixtures are designed mainly on the basis of their ability to withstand a specified number of cycles of wetting and drying and freezing and thawing.

In order to properly design and control the construction of any pavement, bearing tests are essential. Tests should be performed on prepared sections of the subgrade, on the base courses, and on the completed surfaces. Tests conducted to date indicate that a slow static test load represents the most severe condition, gives more consistent results, and is simpler to perform. Therefore it should be used for design instead of some load simulating impact or a moving load.

For the design of rigid pavements, the bearing capacity is taken as the load required to produce a 0.1-in. deflection under a 30-in. bearing plate. The allowable deflection for flexible pavements varies with the type of material encountered; therefore a fixed deflection is not generally applicable. However, investigations conducted to date have shown that the maximum allowable deflection of any type of soil will not exceed 0.2 in., and it may be much less depending on the soil and the number of repetitions of the load. For flexible pavements the allowable deflection is governed more by the underlying soil than by the surface course itself. It is therefore important that the bearing capacity be taken at a deflection which does not exceed the yield point of the soil, so that repeated applications of load will not cause remolding of the soil and a corresponding reduction in bearing capacity.

Concurrent with the present construction program, special investigations are under way which have the aim of determining the relative efficiency of the different types of pavement and subgrade treatment, and of arriving at a more rational method of design for both rigid and flexible pavements for airfields serving the heavier planes. The testing program has been directed toward obtaining information both to guide immediate construction and to form a basis for more rational methods of design. For runway construction the problem resolves itself into three main headings: (1) design of flexible pavements, (2) design of rigid pavements, and (3) required thickness of base courses for both flexible and rigid-type pavements.

In addition to the investigation in progress on flexible pavements, a complete investigation for the design of rigid pavements is in progress. Bearing tests on actual slabs in place are being conducted at Langley, Wright, and Chanute fields. Loads are applied at the center, edge, and corner of the slab. Strain gages are cemented on the surface of the slab and the deflection is measured accurately with specially prepared dial gages.

In conclusion, it should be pointed out that it is entirely feasible to design airport runways capable of supporting the heaviest airplane loads, utilizing either rigid or flexible pavements. Restrictions as to type of paving are governed only by adaptability to the soils at the particular site, availability of materials, and economic considerations. The design methods that have been outlined are based upon the application of the principles of soil mechanics to the problem at hand. The results of investigations and tests will permit extending these methods and possibly even expanding the basic conceptions into a rational theory of design.

Sand-Bituminous Runways Have 6-In. Pavement of Native Sand with Slight Clay Admixture and $4^1/_2$ Gal of Cutback Asphalt per Sq Yd

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Pneumatic Loading of Soil Samples

By E. J. KILCAWLEY

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THE application of a vertical load is necessary in many soil tests. It is often difficult, though always important, to evaluate the volume change of soils under loading. Field loadings are, in general, gradually applied, and after full loading remain constant. These loads are in a sense dead weights and change position to conform to any volume change caused by them. To simulate this condition, a testing apparatus should provide constant loading irrespective of volume change of the test specimens.

To provide this feature, an air cylinder of the type used in paper manufacturing has been utilized in the soil mechanics laboratory of the Rensselaer Polytechnic Institute. By applying pressure both above and below the contained piston, the dead weight may be counterbalanced. Any desired loading within the capacity of the cylinder may be applied by increasing the pressure on one side of the piston. The pressure on the piston is adjusted by operating the regulator, which allows air to pass to the cylinder and controls the quantity to hold the pressure constant at the point set by the regulator. A pressure differential of at least 10 to 15 lb across the control is found essential for best operation. When the pressures have been set, they will remain constant as long as the pressure of the main air supply does not drop below the setting of the regulator, plus a required differential. For any volume change in the specimen, a corresponding displacement of the piston takes place, and more air passes through the control regulator to the cylinder, keeping the loading constant.

The actual load delivered to the test specimen is measured by the deflection of a previously calibrated proving ring placed between the piston rod and the testing block or apparatus. For this reason the line pressure gages are used merely as a guide in loading and any friction in the cylinder does not affect the problem. All proving rings are made from seamless steel tubing 6 in. in outside diameter, No. SAE 2340. A standard width of 1 in. has been adopted, and rings are brought to the desired loading range and sensitivity by removing material from the inside. They therefore all have the same outside diameter and are interchangeable.

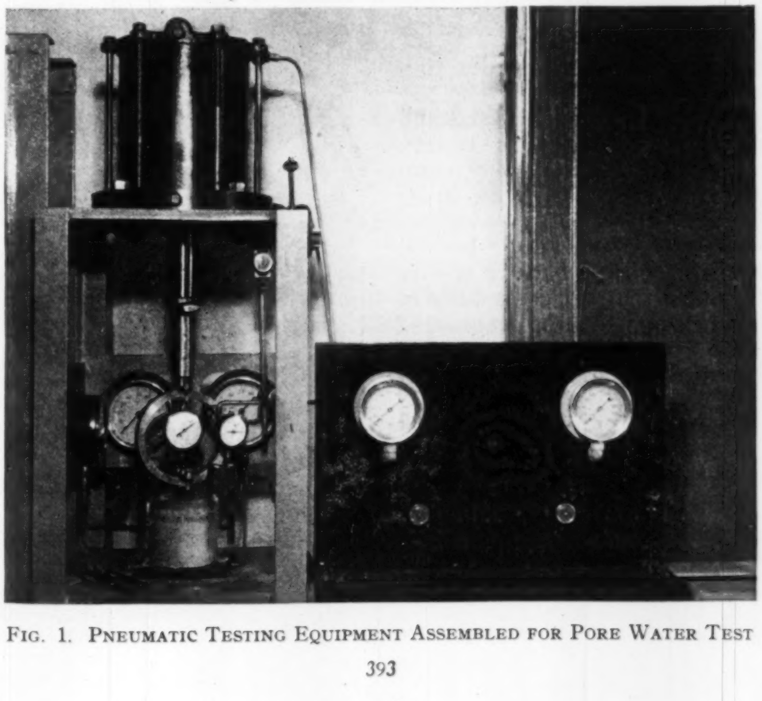

FIG. 1. PNEUMATIC TESTING EQUIPMENT ASSEMBLED FOR PORE WATER TEST

Proving rings were calibrated by dead weights and previously calibrated testing machines. Deflections corresponding to increasing and decreasing increments of loading were read. Maximum variation in loading and unloading was $1^{1}/_{2}$ divisions. The low-range ring has a capacity of 250 lb, and each division has a value of 1.26 lb. The intermediate ring has a capacity of 500 lb and each division has a value of 1.72 lb. The high-range ring has a capacity of 1,000 lb and each division has a value of 8.4 lb. It is believed that under these circumstances loads are accurately determined. Tests show that the variation in any given loading does not vary over 1% during the testing period.

This method of loading has been applied to consolidation, direct-shear, and to tri-axial compression tests. Since the operation is identical in all cases, a single example will be given in detail. For this purpose, the apparatus (Fig. 1) for the consolidation of a specimen 4 in. in diameter and 4 in. thick will be chosen. For a test of this specimen, the steps in the operation of the equipment may be outlined as follows:

1. Operate the piston through its entire stroke in both directions several times by means of the regulators on the panel board.
2. Place the ring to be used in the test on the piston rod, and a suitable bearing block on the testing bed of the frame.
3. Load the ring up to its capacity and unload it four or five times by operating the regulator.
4. Remove the bearing block and properly center the soil specimen in its testing block on the testing bed.
5. From the calibration chart for this ring choose the deflection corresponding to the desired loading.
6. Place a loading of approximately 10 lb per sq in. on both top and bottom of the piston.
7. Slowly move the piston by increasing the pressure on the upper side to bring the convex surface of the lower part of the ring assembly in contact with the ball bearing on the loading plate. Do not place any load on the specimen.
8. Having determined the initial size of the specimen, set the consolidation or vertical deflection dials.

9. Increase the pressure on the upper part of the piston until the required deflection of the proving ring is obtained. This can be done quickly but must be done carefully. Do not overload and do not change the pressure on the lower side of the piston.

10. This setting will remain constant within 1% as long as the main air supply does not fail. The adjustment for volume change is automatic.

11. To change the loading, operate the regulator until the required ring deflection is obtained.

This and similar machines were designed and assembled by the writer in collaboration with S. V. Best, instructor in soil mechanics at Rensselaer Polytechnic Institute. David I. Henderson and Joseph L. Brandes gave much assistance in assembling, calibrating, and testing the apparatus.

Solving a Frame of Multiple Redundancy by Method of Least Work

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SOLUTION of the following problem may be of interest to structural engineers. The frame illustrated in Fig. 1 is of multiple redundancy, and it is required to determine the stresses in the various members due to a vertical load of 20 kips applied at point D.

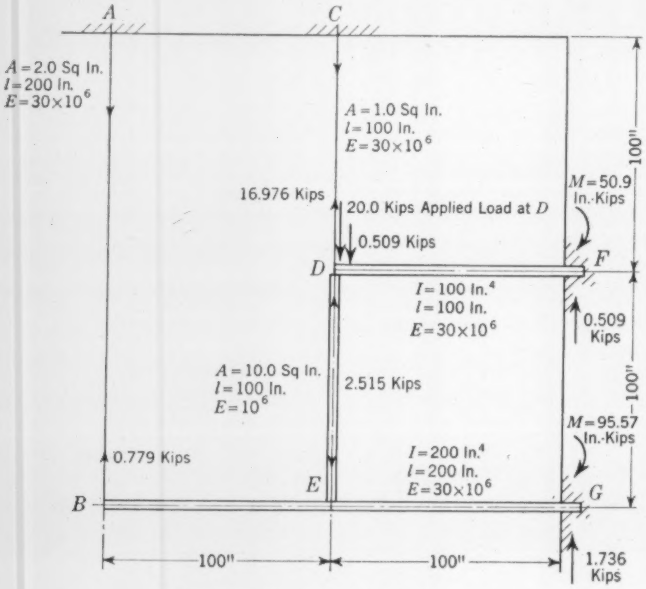


FIG. 1. PLANE FRAMEWORK

All members lie in a vertical plane; members AB and CD are rods; DE is a strut; and DF and BEG are beams. The load is resisted by members acting in tension, compression, and flexure, respectively. The supports at A, C, F, and G are unyielding, and perfect fixity is assumed for the beams DF and BEG at the supports F and G, respectively. The properties of these members are indicated in Fig. 1. It is assumed that the extremities of the three members meeting at point D are so connected that there is no inelastic slip; that is, any movement is common to the ends of the three members connected at that point.

The method used in analysis is the method of least work. This theorem may be stated as follows: The internal work done in any stationary structure by the application of outer forces will be the least possible, consistent with equilibrium.

For members subjected to axial load only,

$$W_i = \frac{1}{2}\frac{P^2 l}{AE}$$

where W_i = internal work
P = total load on member applied gradually
l = length of member
A = cross-sectional area of member
E = Young's modulus

For members subjected to cross bending,

$$W_i = \int \frac{M^2\,dx}{2EI}$$

where M = bending moment at any point x due to gradually applied loads
I = moment of inertia of member about the neutral axis

These expressions are derived in most textbooks on structural analysis. In the solution that follows, the internal work due to shear is neglected. For a frame consisting of n members, some of which are subjected to axial loads and some to cross bending, the total internal work is

$$W_i = \sum_1^n \frac{1}{2}\frac{P^2 l}{AE} + \sum_1^n \int \frac{m^2\,dx}{2EI}$$

In the following problem an expression is written for the internal work in each member in terms of an unknown force P. These terms are added together, giving the total work W_i, which is differentiated with respect to P and equated to zero since the condition for internal work to be a minimum is $dW_i/dP = 0$.

To solve, assume the load in member DE is to be P kips. Owing to the left reaction R, the member AB has lengthened and the left end of the beam BEG has dropped a distance d. It is required to find R in terms of P (Fig. 2).

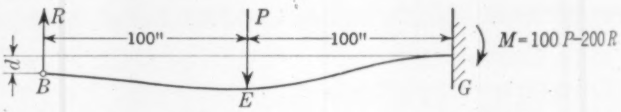


FIG. 2. DEFLECTION CURVE OF MEMBER BG

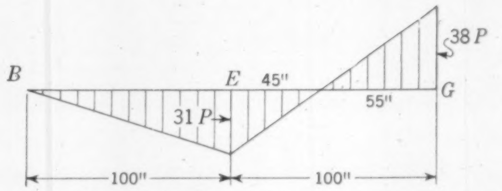


FIG. 3. MOMENT DIAGRAM OF MEMBER BG

W_{AB} (internal work in AB) $= \dfrac{R^2 \times 200}{2 \times 2 \times E} = \dfrac{50R^2}{E}$

$$W_{BEG} = \int_0^{200} \frac{M^2\,dx}{2EI}$$

For segment BE, measuring x from B, $M^2\,dx = R^2x^2\,dx$
For segment EG, $M^2\,dx = R^2x^2\,dx - 2PRx^2\,dx + 200PRx\,dx + P^2x^2\,dx - 200P^2x\,dx + 10{,}000P^2\,dx$

Then, $W_{BEG} = \dfrac{1}{2EI}\left\{ \dfrac{R^2}{3}\Big[x^3\Big]_0^{100} + \dfrac{R^2}{3}\Big[x^3\Big]_{100}^{200} - \dfrac{2PR}{3}\Big[x^3\Big]_{100}^{200} + 100PR\Big[x^2\Big]_{100}^{200} + \dfrac{P^2}{3}\Big[x^3\Big]_{100}^{200} - 100P^2\Big[x^2\Big]_{100}^{200} + 10{,}000P^2\Big[x\Big]_{100}^{200} \right\} =$

$$\frac{1}{6EI}\left[(8 \times 10^6)R^2 - (5 \times 10^6)PR + 10^6P^2\right]$$

Total work, W, in AB and BEG =

$$\frac{1}{1{,}200E}\left[(8.06 \times 10^6)R^2 - (5 \times 10^6)PR - 10^6P^2\right]$$

$\dfrac{dW}{dR} = \dfrac{1}{1{,}200E}\left[(16.12 \times 10^6)R - (5 \times 10^6)P\right] =$ 0 for a minimum.

Therefore $16.12R = 5P$; and $R = 0.31P$.

The moment at $G = 100P - (200 \times 0.31P) = 38P$. Next, it is required to find the deflection of E from the tangent at G (Fig. 3). By moment areas the deflection of $E = \dfrac{38P \times 55}{2 \times 200 \times E} \times 81.7 - \dfrac{31P \times 45}{2 \times 200 \times E} \times 15 = \dfrac{12.5P}{10^6}$. The elastic shortening of $DE = \dfrac{P \times 100}{10 \times 10^6} = \dfrac{P}{10^5}$. By addition, the total vertical movement of point $D = \dfrac{22.5P}{10^6}$.

Let P_i = total stress in member CD.

Then, $\dfrac{P_i \times 100}{1 \times 30 \times 10^6} = \dfrac{22.5P}{10^6}$, and $P_i = 6.75P$

The load carried by beam DF as a cantilever $= (20 - 7.75P)$ kips.

$$W_{CD} = \frac{(6.75P)^2 \times 100}{2 \times 30 \times 10^6} = \frac{75.9P^2}{10^6}$$

$$W_{DE} = \frac{P^2 \times 100}{2 \times 10 \times 10^6} = \frac{5.0P^2}{10^6}$$

$$W_{DF} = \int_0^{100} \frac{400x^2\,dx - 310Px^2\,dx + 60.06P^2x^2\,dx}{2EI}$$

$$= \frac{22{,}222}{10^6} - \frac{17{,}222P}{10^6} + \frac{3{,}337P^2}{10^6}$$

$$W_{AB} = \frac{50 \times (0.31P)^2}{30 \times 10^6} = \frac{0.16P^2}{10^6}$$

$$W_{BEG} = \frac{10^6}{6EI}(0.7688P^2 - 1.55P^2 + P^2) = \frac{6.077P^2}{10^6}$$

By summation, the total internal work in all members, W_i, will be

$$W_i = \frac{3{,}424.14P^2 - 17{,}222P + 22{,}222}{10^6}$$

Then, $\dfrac{dW_i}{dP} = \dfrac{6{,}848.28P - 17{,}222}{10^6} = 0$ for a minimum.

Therefore $P = \dfrac{17{,}222}{6{,}848.28} = 2.515$ kips.

Stress in $AB = 0.31 \times 2.515 = +0.779$ kip.
Stress in $CD = 6.75 \times 2.515 = +16.976$ kips.
Stress in $DE = -2.515$ kips.

Load carried by beam $DF = 20.0 - 19.491 = 0.509$ kip
Moment at $G = 100 \times 2.515 - 200 \times 0.779 = 95.57$ in.-kips.

This problem is purely academic and, it is to be hoped, will not be met with in practice. But the solution illustrates the usefulness of the method of least work.

Concrete Spandrel Beam Blocks

By STEWART S. NEFF, M. AM. SOC. C.E.
ENGINEER, WAR PRODUCTION BOARD, KNOXVILLE, TENN.

IT is of interest that government agencies, as well as many architects and practicing engineers, recommend that reinforcing steel be placed horizontally above and below all windows and doors. It has been definitely proved that there is usually cracking at the point of maximum stress. Consequently, the placing of reinforcing steel will eliminate this trouble.

In connection with the placing of steel, a special spandrel block made as a concrete block is illustrated in Fig. 1. The use of this unit obviates the necessity of expensive forms, with the additional time required. The unit forms a mold to receive the steel and concrete which make up the beam. This makes the beam and mold block monolithic. It also eliminates possible hair cracks in masonry walls caused by settling or other conditions.

This type of block was developed for the Southern Cast Stone Company, of Knoxville, Tenn., by its manager, J. W. Warren. Doubtless other companies also manufacture similar castings or other devices to serve the same purposes.

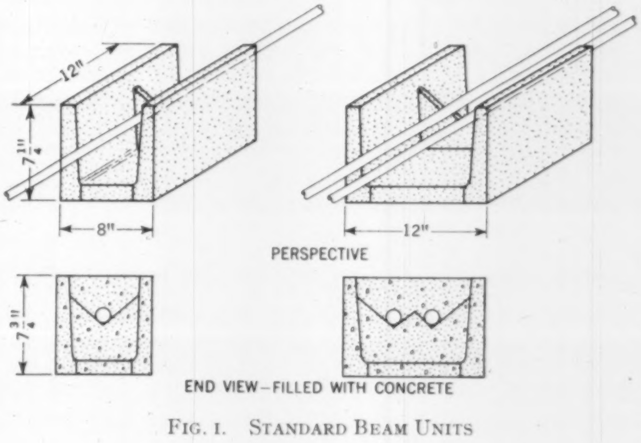


FIG. 1. STANDARD BEAM UNITS

Crest-Stage Meter for Measuring Static Heads

By M. H. COLLET

U.S. FOREST SERVICE, WASHINGTON, D.C.

THE crest-stage meter here described is especially designed to fill a growing need in the fields of hydraulics and hydrology for a low-cost, portable instrument which will register dependably the maximum stage of a body of water. The stage meter registers a given maximum or an instantaneous stage by means of a self-sustaining float within a special piezometer tube.

As shown in Fig. 1, the essential parts of the meter are (1) a streamlined staff gage which serves as a mounting board, (2) a transparent piezometer tube, (3) a float indicator with rubber skirt, and (4) a metal foot mounting unit. The float is of such design that it readily moves upward with rising water in the tube; but when the water recedes it is held at its highest elevation by means of the rubber skirt which acts as a friction unit.

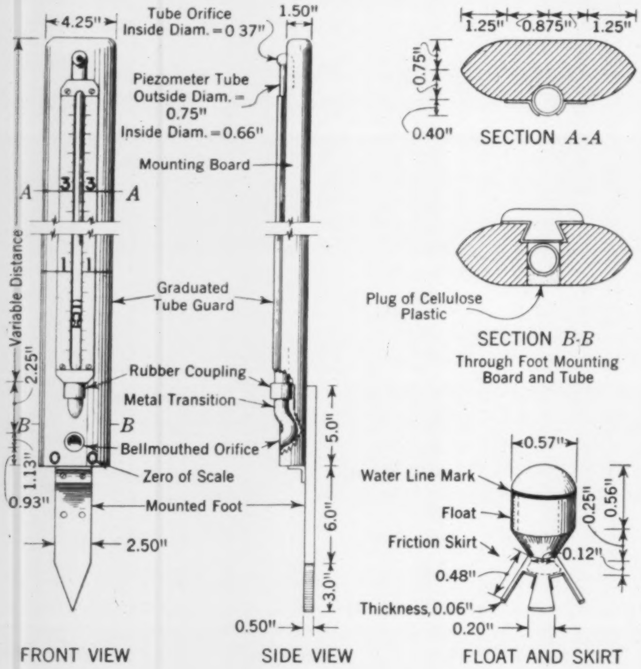

4.25"
Tube Orifice Inside Diam. = 0.37"
1.50"
Piezometer Tube Outside Diam. = 0.75" Inside Diam. = 0.66"
Mounting Board
A
A
Variable Distance
2.25"
Graduated Tube Guard
Rubber Coupling
Metal Transition
B
B
Bellmouthed Orifice
Zero of Scale
1.13"
0.93"
Mounted Foot
2.50"
5.0"
6.0"
3.0"
0.50"
FRONT VIEW
SIDE VIEW
1.25"
0.875"
1.25"
0.75"
0.40"
SECTION A-A
Plug of Cellulose Plastic
SECTION B-B
Through Foot Mounting Board and Tube
0.57"
Water Line Mark
Float
Friction Skirt
0.25"
0.56"
0.12"
0.48"
Thickness, 0.06"
0.20"
FLOAT AND SKIRT

FIG. 1. DETAILED VIEWS OF THE CREST-STAGE METER

In placid water an instantaneous stage is obtained by simply immersing the meter vertically in the water and then withdrawing it. The depth is read from the graduated scale at the indicator line on the float. The float is re-set for another reading by blowing gently into the small orifice at the upper end of the piezometer tube, forcing the float down until it rests on an orifice plate having an opening of 0.25 in., at the bottom of the tube. In moving water, the meter is lowered slowly into the water with its face parallel to the direction of flow; readings are taken after the water within the tube has reached equilibrium.

To obtain an absentee measurement of the crest stage of either placid or moving water, select a firm foundation of known elevation. Using screws or bolts, fasten the detachable metal foot to this with the flat surface parallel to the direction of flow (Fig. 2). Then attach the streamlined mounting board by means of the dovetail lock and blow the float down either to the orifice plate or to a point level with the existing water surface. During any elapsed period of time, the position of the float indicator will show the highest stage attained by the body of water.

The stage meter has been subjected to a number of laboratory tests in order to check its limits of accuracy. Results of 91 comparative tests with a point gage, staff gage, and the stage-meter operated concurrently in placid water, and of 163 similar tests in moving water of various velocities, showed that (1) the crest stage meter gives readings comparable in accuracy to those of the standard staff gage; (2) with the face of the meter parallel to the flow, velocities of less than 6.4 ft per sec had no noticeable effect on the accuracy of the stage meter readings; and (3) the effect of angle-of-incidence of flow upon the face of the meter increases with increased velocities. A velocity of 0.8 ft per sec had no effect on meter readings at angles of less than 45° off parallel, but abnormal stages were registered by the meter at angles greater than 5.5° when velocities were 5.3 ft per sec and higher.

The registering feature of the meter plus its simplicity of operation and low cost make it a handy device for obtaining hydraulic and hydrologic data. The meter can be used for determining the depth of water in open channels, flumes, weirs, spillways, and reservoirs. The depth of water in either poorly lighted or inaccessible tanks, wells, and containers can be obtained with the meter because it automatically registers a given instantaneous stage. In applied hydrology the meter can be used to check the performance of automatic water stage recorders. It can also be used to obtain measurements for determining flood cross sections, flood crests, water-surface elevations, channel storage, maximum stages in ground-water wells, and maximum discharge rates in channels, spillways, and flumes. In general, the meter used either in its present form or in some modified form, will register dependable instantaneous and maximum stages of both still and moving water in a large variety of channels, pools, tanks, and containers.

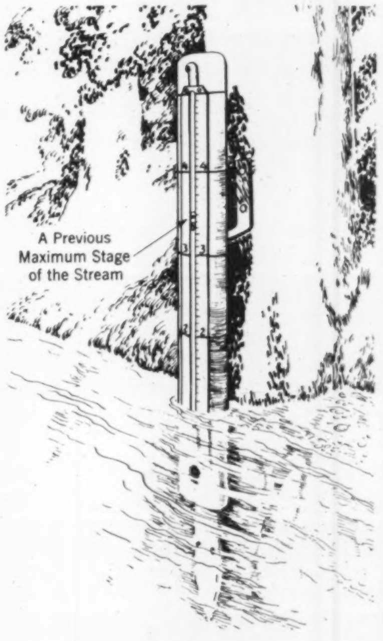

A Previous Maximum Stage of the Stream

FIG. 2. METER AFFIXED TO A TREE GIVES MOMENTARY OR CREST STAGE OF MOVING WATER

United States patent No. 2,266,391 has been granted, and now makes this instrument available for public use without charge.

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Unique Method of Gaging High Water

To the Editor: It was with interest that I read a short article by Capt. Floyd J. Doran, in the February issue of Civil Engineering, in which he described the use of an economic type of high-water gage supplementing a single automatic water level recording station. The type of gage described sounds very satisfactory and is an improvement on gages devised some years ago and later adapted and put into operation under my direction to meet a somewhat similar problem, where water stage records were required at a number of locations on large fast-flowing streams to correspond with flood flows of various magnitudes.

In the case in question the high-water gages consisted of sloping timber racks which housed small medicine bottles laid horizontally with the tops left open, covering being provided to prevent the entrance of rain water. These bottles had their openings spaced 3 in. apart vertically, so that maximum water levels could be determined to within 3 in. by noting the highest bottle containing water after every flood.

Under the circumstances this method was sufficiently accurate for the purpose required, and the installations were very cheap and could be read by any person available from the field parties. These gages functioned very satisfactorily, and I thought that a brief description of the method might prove of some interest in connection with Captain Doran's article.

L. T. Guy, M. Am. Soc. C.E.
Resident Engineer, Kiewa Hydroelectric Works

Victoria, Australia

Comments on Approximate Water-Hammer Formula

To the Editor: There is available a much simpler water-hammer formula than the one proposed by Robert A. Sutherland on page 334 of the June issue of Civil Engineering. It was published by de Sparre, and in terms of the Allievi conduit parameters described in Chapter XXIV of Justin and Creager's *Hydroelectric Handbook* it takes the very simple form

$$\frac{\Delta H}{H} = \frac{2\rho}{2\theta - \rho}$$

with the limitation $\rho > 1$ and $\Delta H < H$.

With the data in Mr. Sutherland's first numerical example, and using the value of $a = 3{,}070$ ft per sec given in his reference, $\Delta H/H = 0.315$ against the 31.4% given. In the second example, using $a = 3{,}460$ from his reference, $\Delta H/H = 0.252$ against the 25.3% given.

For the case $\rho < 1$ de Sparre gives another formula, most conveniently expressed in the form

$$\frac{\Delta H}{H} = \frac{\theta + \rho\theta + \rho}{\theta + \rho\theta - \rho}$$

It is desirable always to express approximate water-hammer formulas in terms of the Allievi parameters ρ and θ because the numerical values give some idea of classification of the conduit in terms of behavior. Furthermore, only by plotting the formula on the Allievi diagrams, which have these parameters as coordinates, can the permissible zone of use and the degree of error be determined.

The formula given by Mr. Sutherland can be transformed into $\frac{\Delta H}{H} = 1.322\left(\frac{\rho}{\theta}\right)^{1.10}$, and by giving the left-hand side various values, the equation between ρ and θ is a series of straight lines passing through the origin of the Allievi chart of maximum water hammer. For $\Delta H/H = 0.25$ or $\rho = 0.220\theta$ the agreement with Allievi is good. For $\Delta H/H = 1.00$, it gives results about 5 or 6% high in the field recommended. In the same field, de Sparre is 3 or 4% low.

J. B. Macphail, Assoc. M. Am. Soc. C.E.

Montreal, Canada

Bridges Thought to Be Fairly Safe from Air Attack

To the Editor: The article by Sherwood B. Smith on "Protective Aspects of Civilian Defense," in the May issue of Civil Engineering, is not only timely but very instructive. Mr. Smith points out the fact that "...we have a large number of suspension bridges, which might require some special treatment since the cables where they pass over the saddle and where they enter the anchorages are particularly vulnerable to a direct hit from a bomb." It is true that everything is possible in time of war, but modern anti-aircraft located on the tower tops and at other strategic locations on the bridges would provide invaluable protection against direct hits from bombs.

While on this subject, it might be of interest to discuss the experience of the Allied armies in the World War, showing that attacks from the air upon bridges were not deemed sound military procedure. In August 1928 during a conference concerning the proposed "Liberty Bridge" project across the Narrows in New York Harbor, Squadron Leader A. R. Boyle, of the British Directorate of Air Intelligence in London—the officer who planned the independent air raids into Germany—was asked whether the railway bridges over the Rhine River were the object of attack from the air, and, if so, what the results were. Mr. Boyle displayed the official records and photographs taken during the war, and stated that "...the destruction of the railway or other bridges over the Rhine was not considered sufficiently feasible to make such bridges objectives of attack..." He went on to say that these bridges had therefore been ignored except for instructions to the effect that if any bombs were unused they might, if possible, be dropped upon a bridge for lack of a better target. "As a matter of fact," he said, "...no bridge had been destroyed or interrupted from the air and the effort to do so was not deemed worth making."

In direct reference to the proposed Narrows Bridge, Mr. Boyle said "that similar conditions to those existing upon the Rhine would apply to the Harbor of New York for, with a target as large as that presented by the City of New York itself close at hand, no one would make the unnecessary and indecisive attack upon the bridge." He suggested that "an air officer pursuing such a course would be incompetent."

Records show that about 80 cities in Germany were bombed, and that about 685 air raids were conducted by the Allied air forces. However, no record has been found to show that any bridges were destroyed.

It has been conceded by eminent bridge authorities that a wire-cable suspension structure is the most invulnerable type of bridge construction. Unlike other types, a suspension bridge cannot be brought down by bombardment, wrecking, or failure of any part or parts of the suspended span. The cables are the only essential elements of the span, and they must be severed or brought down before the span can be wrecked.

Not only were these facts brought out in connection with the proposed "Liberty Bridge," but similar statements were also made by eminent bridge and military engineers in connection with the proposed Brooklyn-Battery Bridge and the Golden Gate Bridge.

All of these facts and statements, it seems to the writer, bear out Mr. Smith's contention that "Bridges suffer very little on the whole." Rather, as Mr. Boyle points out, the adjacent cities are the vulnerable targets.

Theodore Belzner, Affiliate Am. Soc. C.E.

Brooklyn, N.Y.

The Degree of Randomness in Weather Data

DEAR SIR: The method of analyzing the degree of randomness in weather data, as given by R. Evan Kennedy in the January issue of CIVIL ENGINEERING, appears to be simple and based upon sound mathematical grounds. Since the test may be applied not only to meteorological data but also to other types of time series of importance to the engineer, it may be of interest to indicate two ways in which the analysis can be extended to increase its usefulness.

The first of these applies when the number of items in the series is small. If this is the case then the number of items m should be increased by two $(m + 2)$ to account for the possibility that the end groups in the series may not be complete. Thus Mr. Horton's formula, as given by Mr. Kennedy, would be $k = (m + 2) \div 2G$, where k is the coefficient of periodicity. The mathematical derivation of this end correction, though not difficult, is too long to be presented here. While the foregoing modified formula is theoretically correct for all values of m, the neglect of the term 2 does not invalidate the result for the large values of m mentioned by Mr. Kennedy. However for small values, say less than 30, the omission of the correction term may render the result meaningless.

Another extension of the analysis deals with the interpretation of the coefficient of periodicity (k). The question is how far may k deviate from unity before it can be reasonably certain that periodic influences and not mere chance affect the sequence at hand. Mr. Kennedy indicated that a value of $k = 1.35$ was a satisfactory criterion in his study. Theoretical considerations bear out this selection as being reasonable for the data he has presented. However it will be evident upon reflection that the limits of k obtained in random series are dependent to some extent on the number of items m in the sequence. To show this relationship quantitatively, a simple formula was developed following the well-known Bernoullian method of analysis. In a random sequence of m items, there is a 90% chance that the value of k will fall within the limits of $\sqrt{m} \div (\sqrt{m} \pm 1.65)$. In other words, there is a 5% chance that k will exceed $\sqrt{m} \div (\sqrt{m} - 1.65)$ and a 5% chance that k will be less than $\sqrt{m} \div (\sqrt{m} + 1.65)$.

Therefore, a 100-year record of annual rainfall with a value of k greater than $\sqrt{100} \div (\sqrt{100} - 1.65)$ or 1.20 might be regarded as being cyclic, although there is a 1 in 20 chance that a random sequence of this length could deviate from unity by this amount. Certainly the value of $k = 1.35$ delimits for practical purposes the maximum variation likely to occur in random series of about 100 items. With larger or smaller series the limits of k vary widely and may be estimated from the foregoing expressions.

HAROLD A. THOMAS, JR.
Instructor, Harvard Graduate
School of Engineering

Cambridge, Mass.

"The First P. I."

DEAR SIR: The attached snapshot would be just an ordinary picture of a boy and a transit were it not for the position of the boy's hands.

It takes years of transit work to assume such a nonchalant attitude of hand signaling. It is so natural it couldn't have been posed. Do you suppose it is in the blood?

This four-year-old youngster might have inherited the knack from . . .

BENJAMIN A. MORGAN, JR.
Assoc. M. Am. Soc. C.E.
Resident Engineer, J.E.
Sirrine & Company

Greenville, S.C.

"LEFT, A HAIR!"

Accelerating Engineering Courses

DEAR SIR: On page 288 of the May issue of CIVIL ENGINEERING there is a summary of the report of the Committee on Accelerating Engineering Courses of the Society for the Promotion of Engineering Education. The first sentence of the third paragraph states: "Dates for graduation are advanced as follows: May, 17 colleges; first half of June, 53 colleges; second half of June, 23 colleges; and July, 4 colleges." This statement is in error, as the dates in question refer to the openings of the summer terms.

D. B. PRENTICE
Chairman, Committee on Accelerating
Engineering Courses, S.P.E.E.

Terre Haute, Ind.

Variations in Correction Factors for Pipes and Open Channels

TO THE EDITOR: The article by Victor L. Streeter on "The Kinetic Energy and Momentum Correction Factors for Pipes and for Open Channels of Great Width," in the April issue, deserves a permanent place in every hydraulic engineer's notebook. The curves give a good picture of the variation of the two correction factors over a wide range of turbulent flow in straight pipes and wide uniform channels. Values of these correction factors as previously determined, from actual velocity traverses, are probably more accurate for the particular flow conditions they represent, but they do not reveal the general trend of variation with the friction coefficient. The widest range of measured values known to the writer is that given by M. P. O'Brien and J. W. Johnson in "Velocity-Head Correction for Hydraulic Flow," in *Engineering News-Record*, for August 16, 1934.

It should be noted that the expressions for K_e and K_m used by Professor Streeter have to be modified if the possibility of inclined or reversed components of filament velocities is to be allowed for. The general expressions are given in *Hydraulics of Steady Flow in Open Channels* by Sherman M. Woodward, M. Am. Soc. C.E., and the writer. Using Professor Streeter's notation, they are

$$K_e = \frac{1}{AV^3}\int v^2 v_n dA$$

and

$$K_m = \frac{1}{AV^2}\int |v_n| v_n dA$$

In each case v_n represents the component of the velocity perpendicular to the element of area dA. It is to be considered positive if downstream and negative if upstream. In the first expression v_n serves the double purpose of insuring that the discharge through dA is correctly evaluated and that the kinetic energy of upstream currents is subtracted in performing the integration. In the second expression the discharge has to be multiplied by the absolute value of the normal component of the velocity. The normal component must be used to obtain the longitudinal component of the momentum, and the absolute value sign is necessary to prevent the momenta of upstream currents from being additive instead of subtractive.

The coefficient K_e is chiefly important in precise laboratory investigations of fluid flow. Its use in Bernoulli's equation, when other factors are the unknowns, should be attended with caution.

For example, indiscriminate use of a high value of K_e at an upstream section might classify as available for conversion, or for overcoming friction losses, kinetic energy which would surely be dissipated in eddies and turbulence.

Finally, it is interesting to compare the values of K_e and K_m obtained by Professor Streeter with the corresponding values of laminar flow. For both infinitely wide rectangular channels and circular pipes, $K_e = 2.00$ and $K_m = 1.33$ if the flow is laminar.

C. J. POSEY, Assoc. M. Am. Soc. C.E.
Associate Professor of Hydraulics
and Structural Engineering, State
University of Iowa

Iowa City, Iowa

Seventy-Second Annual Convention

University of Minnesota, Minneapolis, Minn., July 21, 22, 23, 1942

Registration, Opening Session, and Technical Meetings

Coffman Memorial Union

WEDNESDAY—July 22, 1942—Morning

9:00 **Registration in the Main Lounge**

10:00 **Convention called to order in the Main Ballroom by**

GEORGE J. SCHROEPFER, *President, Northwestern Section, Am. Soc. C.E.; Chief Engineer and Superintendent, Minneapolis–St. Paul Sanitary District*, St. Paul, Minn.

10:05 **"America" by all assembled, led by**

OTTO S. ZELLNER, *Associate Professor, Civil Engineering, University of Minnesota.*

Addresses of welcome

10:10 SAMUEL C. LIND, *Dean, Institute of Technology, University of Minnesota.*

10:17 The Hon. MARVIN L. KLINE, *Mayor of the City of Minneapolis.*

10:24 GEORGE C. PRIESTER, *President, The Engineers' Club of Minneapolis.*

10:30 **Response by**

MAJ. E. B. BLACK, *President, American Society of Civil Engineers.*

10:35 **Annual Address**

MAJ. E. B. BLACK, *President, American Society of Civil Engineers.*

11:15 **Economics in the War Efforts**

RUSSELL A. STEVENSON, *Dean, School of Business Administration, University of Minnesota.*

11:45 **Business meeting**

12:00 **Luncheon recess**

WEDNESDAY—July 22, 1942—Afternoon

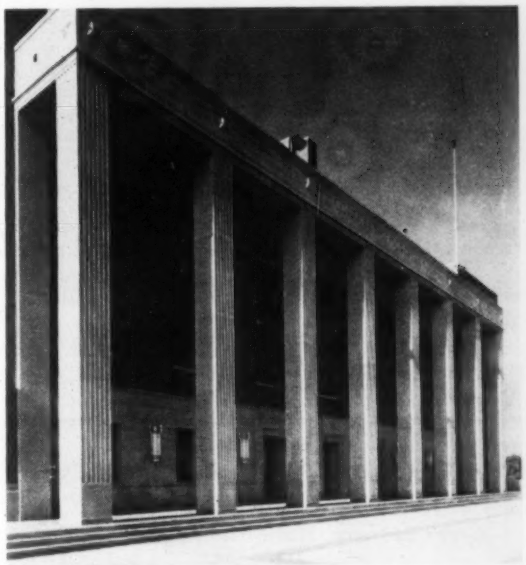
SYMPOSIUM ON CIVILIAN PROTECTION IN WAR TIME

2:00 p.m. Main Ballroom, Coffman Memorial Union

THOMAS E. STANTON, *Vice-President, Am. Soc. C.E., Chairman of the Meeting*

ERNEST P. GOODRICH, *Director, Am. Soc. C.E.; National Chairman, Society's National Committee on Civilian Protection in War Time, Presiding*

This symposium has been prepared and is presented by the Society's National Committee on Civilian Protection in War Time. This program is presented as part of the Society's contribution in giving technical aid to protect the lives and property of civilians.



COFFMAN MEMORIAL UNION

2:00 **Introductory remarks**

ERNEST P. GOODRICH, *M. Am. Soc. C.E.; Consulting Engineer*, New York, N.Y.; *National Chairman, Society's National Committee on Civilian Protection in War Time.*

2:05 **Engineering Problems of Civilian Evacuation**

CHARLES B. BREED, *M. Am. Soc. C.E., Professor, Civil Engineering, and Head of Department of Civil and Sanitary Engineering, Massachusetts Institute of Technology*, Cambridge, Mass.; *Chairman, Transportation Division, Society's National Committee on Civilian Protection in War Time.*

2:45 **Discussion**

2:55 **Industrial Camouflage**

MAJ. DONALD P. BARNES, *Corps of Engineers, U.S.A., Assoc. M. Am. Soc. C.E., Camouflage Section, Engineer Board*, Fort Belvoir, Va.

3:35 **Discussion**

3:45 **If You Were a Saboteur—A Colloquy**

ALLEN J. SAVILLE, *M. Am. Soc. C.E., Consulting Engineer*, Richmond, Va.; *Chairman, Emergency Control and Local Application Division, Society's National Committee on Civilian Protection in War Time.*

Interlocutor: ERNEST P. GOODRICH, *M. Am. Soc. C.E., Consulting Engineer*, New York, N.Y.; *National Chairman, Society's National Committee on Civilian Protection in War Time.*

4:35 **Open discussion**

5:00 **Adjournment**

Wednesday Luncheon for Men

12:15 p.m., Junior Ballroom, Coffman Memorial Union

At the close of the Wednesday morning session, there will be a luncheon for members and men guests in the Junior Ballroom, Coffman Memorial Union.

RALPH BUDD, *Hon. M. Am. Soc. C.E.; President, Chicago, Burlington and Quincy R.R.*, Chicago, Ill., will address the luncheon on

"THE PLACE OF TRANSPORTATION IN THE WAR EFFORT"

Tickets for the luncheon are 75 cents each.

Hydraulics Division

WEDNESDAY—July 22, 1942—Afternoon

St. Anthony Falls Hydraulic Laboratory
University of Minnesota

Minnesota Department of Health Building
University of Minnesota Campus

Hydraulic Laboratory

The Laboratory is situated on Hennepin Island at the head of St. Anthony Falls. It is about a mile upstream of the Main Campus of the University, on the east side of the river, at the foot of Third Avenue Southeast.

Paul R. Speer, *Assoc. M. Am. Soc. C.E., District Engineer, U.S. Geological Survey, Department of Interior,* St. Paul, Minn., *Presiding*

2:15 Wartime Water Supply Problems

Capt. Ray E. Lawrence, *Corps of Engineers, U.S.A.; Assoc. M. Am. Soc. C.E., Chief, Water and Sewage Unit, Engineering Branch, Construction Division, Office of Chief of Engineers,* Washington, D.C.

2:45 Discussion opened by

E. L. Filby, *M. Am. Soc. C.E., Principal Assistant Engineer, Black and Veatch,* Kansas City, Mo.

3:00 Monthly Summaries of Stream Flow

Walter B. Langbein, *Assoc. M. Am. Soc. C.E., Associate Engineer, Division of Water Utilization, U.S. Geological Survey,* Washington, D.C.

3:30 Discussion

4:00 Demonstration of Laboratory Practices and Inspection of St. Anthony Falls Hydraulic Laboratory

Lorenz G. Straub, *M. Am. Soc. C.E., Director, St. Anthony Falls Hydraulic Laboratory,* Minneapolis, Minn.; *Member, Committee on Hydraulic Research, Am. Soc. C.E.*

5:00 Adjournment

Formal Dinner and Address

WEDNESDAY—July 22, 1942—7:00 p.m.

Grand Ballroom, Hotel Nicollet, Minneapolis

George J. Schroepfer, *President, Northwestern Section, Am. Soc. C.E., Toastmaster*

Dr. Walter H. Judd, a Minneapolis surgeon who worked in China for more than ten years and spent many months in northern China hospitals during the Japanese invasion, will speak on

"BEHIND THE CONFLICT IN THE PACIFIC"

Special entertainment and music for dancing will follow the dinner.

Tickets are $3.50 for members and men guests and $2.50 for their ladies. Special tickets for Juniors are $2.50 and for their ladies $1.50.

Interior View of Laboratory

View of Falls and Laboratory Building

St. Anthony Falls Hydraulic Laboratory, University of Minnesota

Local Sections Conference

TUESDAY—July 21, 1942—All Day

Rooms 343, 344, 345, Coffman Memorial Union

William M. Spann, *Chairman, Society's Committee on Local Sections, Presiding*

The second Regional Local Sections Conference for 1942 will include 27 Local Sections of the Western and Mid-Western areas of the country. All interested members of the Society are invited to attend and are urged to participate in the discussions. The official representatives will discuss generally the following main subjects, and in detail, the specific titles listed below:

CIVILIAN PROTECTION ACTIVITIES OF LOCAL SECTIONS

EMPLOYER-EMPLOYEE RELATIONSHIPS IN THE ENGINEERING PROFESSION

ACTIVITIES OF LOCAL SECTIONS DURING WARTIME

Morning, 9:30–12:00

9:30 **Address of Welcome**

George J. Schroepfer, *President, Northwestern Section, Am. Soc. C.E.*, Minneapolis, Minn.

9:45 **Introduction of Local Section Representatives**

William M. Spann, *M. Am. Soc. C.E., President, Tuttle-Ayers-Woodward Engineering Co.*, Kansas City, Mo.; *Chairman, Society's Committee on Local Sections.*

9:50 **CIVILIAN PROTECTION ACTIVITIES OF LOCAL SECTIONS**

Ernest P. Goodrich, M. *Am. Soc. C.E., Consulting Engineer*, New York, N.Y.; *National Chairman, Society's National Committee on Civilian Protection in War Time*, will present an outline of the type of work in which Local Sections are expected to participate, and the results obtained by some of them.

10:15 **Response by each Local Section representative**

12:00 **Adjournment**

12:15 **Luncheon**

Local Section representatives will join members of the Board of Direction at luncheon in the Terrace Restaurant, Coffman Memorial Union.

Maj. E. B. Black, *President, American Society of Civil Engineers*, will address the luncheon on

"THE SOCIETY'S CONTRIBUTION TO THE WAR EFFORT"

Tickets for the luncheon are 75 cents each.

Afternoon, 2:00–5:00

2:00 **EMPLOYER-EMPLOYEE RELATIONSHIPS IN THE ENGINEERING PROFESSION**

Howard F. Peckworth, *Assistant to the Secretary, Am. Soc. C.E.*, New York, N.Y.

2:30 **Response by each Local Section representative**

3:45 **ACTIVITIES OF LOCAL SECTIONS DURING WARTIME**

(*a*) Stimulation of Interest Among Local Section Members During Wartime
(*b*) Local Section Records and Activities as Influenced by Wartime Conditions
(*c*) Local Section Activities in Post-War Period
(*d*) Importance of Engineers in Administrative Position
(*e*) Activities of Local Section Committees

5:30 **Adjournment**

Northwestern Section Dinner

TUESDAY—July 21, 1942—7:00 p.m.

Terrace Restaurant, Coffman Memorial Union

Members of the Board of Direction, and representatives of Local Sections, together with their ladies, will join the members of the Northwestern Section and their ladies at dinner at 7:00 p.m. in the Terrace Restaurant, Coffman Memorial Union.

Following dinner, there will be an address by Harold C. Deutsch, *Associate Professor, Department of History, University of Minnesota*, on

"RUSSIA AND THE WAR"

Tickets for the dinner are $1.10 each.

Ladies' Luncheons, Teas, and Entertainment

TUESDAY—July 21, 1942

Morning **Shopping**

12:30 p.m. **Luncheon at Women's Club**

Tickets for the luncheon are $1.00.

2:30 p.m. **Sightseeing Tour of Minnetonka Homes and Gardens**

7:00 p.m. The ladies will join members at informal dinner in Terrace Restaurant, Coffman Memorial Union, University of Minnesota

Tickets for the informal dinner are $1.10.

WEDNESDAY—July 22, 1942

10:00 a.m. **Opening Session of the Convention**

In the Main Ballroom, Coffman Memorial Union, University of Minnesota.

1:00 p.m. **Luncheon at Dayton's Tea Rooms**

Tickets for the luncheon are $1.00.

7:00 p.m. The ladies will join members at formal dinner and address followed by dancing in the Grand Ballroom, Hotel Nicollet.

See men's program for further details regarding the formal dinner, address, and price of tickets.

THURSDAY—July 23, 1942

12:30 p.m. **Luncheon at Young-Quinlan's Tea Room**

Afternoon **Entertainment**

Evening After the close of the Technical Divisions' sessions on Thursday, the ladies will be joined by the men to take in the events of the Minneapolis Aquatennial.

Sessions of Technical Divisions

THURSDAY—July 23, 1942—Morning

SANITARY ENGINEERING DIVISION

Men's Lounge, Coffman Memorial Union

LINN H. ENSLOW, *Chairman, Executive Committee, Presiding*

9:30 Operation of Army Sewage Plants

LEWIS H. KESSLER, *Assoc. M. Am. Soc. C.E., Chief, Water, Sewer and Services Unit, Repairs and Utilities Branch, Construction Division of the War Department,* Washington, D.C., and JOHN T. NORGAARD, *Associate Sanitary Engineer, Water, Sewer and Services Unit, Repairs and Utilities Branch, Construction Division of the War Department,* Washington, D.C.

10:00 Discussion

EXPERIENCES IN THE OPERATION OF THE TWIN CITIES' WATER SOFTENING PLANTS

10:10 (*a*) Minneapolis Plant

A. E. JENSEN, *Superintendent of Water Works,* Minneapolis, Minn.

10:25 (*b*) St. Paul Plant

L. N. THOMPSON, *Superintendent of Water Department,* St. Paul.

Discussion by

10:40 MELVIN P. HATCHER, *M. Am. Soc. C.E., Chief Engineer and Superintendent, Kansas City Water Department,* Mo.

10:50 CHARLES H. SPAULDING, *Supervising Chemist, Department of Water, Light and Power,* Springfield, Ill.

11:00 General discussion

UTILITIES PREPAREDNESS PROGRAM OF THE CITY OF CHICAGO

11:10 (*a*) Chicago Civilian Defense Plan for Sewers

Joint paper by THOMAS GARRY, A. J. SCHAFMAYER, *M. Am. Soc. C.E.,* HARRY M. FORREY, and TENNEY S. FORD, *of the Department of Public Works,* Chicago, Ill.

To be presented by THOMAS GARRY, *Superintendent of Sewers, Department of Public Works,* Chicago, Ill.

11:25 (*b*) Simulated Emergency Repair of Large Water Mains

B. W. CULLEN, *Superintendent of Water Pipe Extension, Department of Public Works,* Chicago, Ill.

11:40 Discussion

12:00 Adjournment

Thursday Luncheon

12:15 p.m.

Junior Ballroom, Coffman Memorial Union

At the close of the Thursday morning sessions, there will be a luncheon in the Junior Ballroom, Coffman Memorial Union. MAJ. LYNN C. BARNES, *Corps of Engineers, U.S.A., Area Engineer, Twin Cities Ordnance Plant,* St. Paul, Minn., will address the luncheon on

"THE USE OF CRITICAL MATERIALS IN WAR TIME"

Tickets for the luncheon are 75 cents each.

CONSTRUCTION DIVISION

Game Room, Coffman Memorial Union

HARRY O. LOCHER, *Chairman, Executive Committee, Presiding*

Construction in both volume and rate exceeds figures ever before reached. New equipment, new methods, and new procedures have enabled American engineers in cooperation with American contractors to construct war projects with unprecedented speeds.

9:30 Introductory remarks

HARRY O. LOCHER, *M. Am. Soc. C.E., Secretary-Treasurer, The National Association of River and Harbor Contractors,* New York, N.Y.

A SYMPOSIUM ON ENGINEERING FEATURES OF CONSTRUCTION OF WAR PROJECTS

9:40 A California Cantonment

CHARLES T. LEEDS, *M. Am. Soc. C.E., Consulting Engineer, Leeds, Hill, Barnard and Jewett,* Los Angeles, Calif.

10:10 Discussion

10:20 A Minnesota Ordnance Plant

ARNDT J. DUVALL, *Assoc. M. Am. Soc. C.E., Toltz, King and Day, Inc.,* St. Paul, Minn.

10:50 Discussion

11:00 An Alabama Ordnance Depot

ARMOUR C. POLK, *M. Am. Soc. C.E., Consulting Engineer,* Birmingham, Ala.

11:30 General discussion

12:00 Adjournment

THURSDAY—July 23, 1942—Afternoon

CITY PLANNING DIVISION

Game Room, Coffman Memorial Union

HARLAND BARTHOLOMEW, *Chairman, Executive Committee, Presiding*

2:00 Effect of War-Induced Migration Upon Urban Communities

ROBERT K. LAMB, *Staff Director, House Committee on National Defense Migration,* Washington, D.C.

2:40 Discussion

3:00 Integrating Long-Range Planning with the Post-War Works Program

Speaker to be announced.

3:40 Discussion

5:00 Adjournment

STRUCTURAL DIVISION

Men's Lounge, Coffman Memorial Union

CHARLES A. ELLIS, *Member, Executive Committee, Presiding*

TIMBER AND PLAIN CONCRETE ARCHES PINCH HITTING FOR STRUCTURAL STEEL

2:00 Introductory remarks by

CHARLES A. ELLIS, *M. Am. Soc. C.E., Professor, Structural Engineering, Purdue University,* West Lafayette, Ind.

2:03 Timber Structures

LAURENCE P. KEITH, *Assoc. M. Am. Soc. C.E., Manager, Chicago Office, National Lumber Manufacturers Association,* Chicago, Ill.

2:43 Discussion led by

R. P. A. JOHNSON, *Wood Consultant, War Production Board,* Washington, D.C.

3:13 Plain Concrete Arches

CHARLES S. WHITNEY, *M. Am. Soc. C.E., Consulting Engineer,* Milwaukee, Wis.

3:53 Discussion led by

VICTOR H. COCHRANE, *M. Am. Soc. C.E., Consulting Engineer,* Tulsa, Okla.

4:23 Recent Methods in Shipbuilding—Illustrated

J. LYELL WILSON, *Assistant Chief Surveyor, American Bureau of Shipping,* New York, N.Y.

5:00 Adjournment

Hotel Accommodations and Announcements

Hotel Rates

Hotels	With Private Bath Single	Double	Twin Bed
Nicollet Hotel, Minneapolis, Minn.	$3.30 up	$5.00 up	$5.50 up
*Curtis Hotel, Minneapolis, Minn.	2.00 up	3.00 up	4.50 up

* Special rates offered for family groups.

Pioneer Hall Men's Dormitory, University of Minnesota

Additional accommodations for single men are available at $1.00 per person. in the new men's dormitory in Pioneer Hall. The quarters consist of student suites made up of two bedrooms separated by a common study. Occupants of these quarters will have access to showers in the general lavatories on each floor.

The Nicollet Hotel, in downtown Minneapolis, is Hotel Headquarters for the Annual Convention.

Registration and technical sessions are in the Coffman Memorial Union on the University of Minnesota campus. The Union is on Washington Avenue, two miles east of the Nicollet Hotel, by street car, bus or taxi.

Advance Reservations

To be certain of hotel accommodations, members are urged to make reservations in advance of the meeting date with the manager of the hotel of their choice, or with the Director of Pioneer Hall on the University of Minnesota campus.

Everyone attending the Annual Convention is expected to register in the Main Lounge of the Coffman Memorial Union on the University campus.

Tickets and badges will be obtained at the time of registering.

Information

An Information Desk will be provided in the Main Lounge of the Coffman Memorial Union, to assist visiting members and to furnish information about the meeting and the campus.

Train travel to Minneapolis is convenient and accommodations ample, but members contemplating using rail service are urged to make their rail and pullman reservations to and from Minneapolis just as far in advance as possible.

Entertainment for the Ladies

Attention is directed to the program arranged by the Ladies' Entertainment Committee of the Northwestern Section for the visiting ladies. However, they may participate with members in the other features of the program.

Local Sections Conference, Tuesday, July 21, 1942

A conference of representatives of Local Sections will meet at 9:30 a.m., Tuesday, July 21, 1942, in Rooms 343-4-5, in the Coffman Memorial Union on the University campus. The program will schedule topics of professional rather than technical interest in which all representatives are expected to participate. All members of the Society present on Tuesday are welcome to attend. The program is shown in detail on a preceding page.

Men's Lounge, Coffman Memorial Union
Some Technical Sessions Will Be Held Here

HOTEL NICOLLET

Nicollet Hotel, Minneapolis, Minn., Hotel Headquarters

Dress

Because of the war, it has been decided that only at the Wednesday evening dinner will dinner jackets be in order. All other functions will be informal.

Officers of the Northwestern Section

George J. Schroepfer, *President*
George M. Shepard, *Vice-President*
Paul R. Speer, *Vice-President*
Frank S. Altman, *Secretary-Treasurer*

Northwestern Section's Committee on Arrangements

Paul R. Speer, *Chairman*

Frederic Bass
M. H. Berg
Edgar A. Goetz
Frederick T. Paul
Lorenz G. Straub
Theodore W. Thomas

Ladies' Entertainment Committee

Mrs. Frederic Bass, *Chairman*

Mrs. Frank S. Altman
Mrs. Paul Anderson
Mrs. M. H. Berg
Mrs. Bernard A. Blum
Mrs. J. A. Childs
Miss Katherine Feucht
Mrs. Edgar A. Goetz
Mrs. Miles S. Kersten
Mrs. George E. Loughland
Mrs. John S. McNown
Mrs. Frederick T. Paul
Mrs. George J. Schroepfer
Mrs. George M. Shepard
Mrs. Paul R. Speer
Mrs. Paul L. Thomas

This program has been prepared under the direction of the Annual Convention Committee composed of Thomas E. Stanton, *Vice-President, Am. Soc. C.E., Chairman;* and John W. Cunningham, Charles G. Hyde, John T. L. McNew, and A. M. Rawn, *Directors, Am. Soc. C.E.*

The speakers on this program who have consented to be present at this meeting are making a direct tangible contribution to aid our members in helping the Government to win the war. Nevertheless, the speakers have accepted invitations to speak contingent upon emergencies that may develop.

SOCIETY AFFAIRS

Official and Semi-Official

Presentation of Papers and Discussions

To INCREASE the interest and success of the meetings of the Society's Technical Divisions, the following suggestions have been approved by the Committee on Technical Procedure for the guidance of those presenting or discussing papers:

1. Do not read manuscript: this tends to destroy attention and interest. Instead, prepare in advance a well-planned outline of what you are to say, using, if necessary, memorandum cards to recall successive points to memory.

2. Select only the high-spots of the subject matter for oral presentation. Mathematical, statistical, or involved material cannot be effectively presented and should be reserved for the printed publication.

3. Plan your opening sentences before you get up to speak.

4. Face your audience. Look at your audience. Speak to your audience. If a microphone is provided, it is courteous to use it; talk into the microphone.

5. Pitch your voice so that it will be clearly heard by those in the farthest seats. Avoid a monotone; it is desirable occasionally to change the pitch or quality of your voice for emphasis or to retain attention.

6. Be brief. A talk is rarely effective after the first twenty minutes. A discussion should be much briefer, especially when the program is lengthy.

7. Relax. Avoid strain in posture or in voice. A touch of natural humor or human interest will add to the effectiveness of the presentation.

8. Use lantern slides or other illustrative material where suitable. In a lantern slide presentation, it is particularly important to avoid monotony of voice or subject matter, since the accompanying conditions of light and atmosphere are inherently of a soporific nature. Do not face the screen in explaining lantern slide illustrations, as only the nearest members of the audience will then be able to hear your remarks.

9. Be kindly. Avoid self-advertising. Avoid disparagement of others. Treat differences of opinion with courtesy.

10. Plan your concluding sentences before you get up to speak. When a time limitation prevents completion of all you planned to present, or when you are at a loss for things to say, go straight to your conclusion as an effective ending.

Audiences appreciate brevity and a lively presentation.

(*Leaflet copies of these hints are available on request to Society Headquarters.*)

North Central Conference of Student Chapters

Eight of the fourteen Regional Student Chapter Conferences, held under the auspices of the Society's Committee on Student Chapters during the past spring, were reported in the June issue of "Civil Engineering." Word of another conference—at Cleveland, Ohio—has now been received at Society Headquarters.

ON April 16 and 17 the Chapter at the Case School of Applied Science was host to the North Central Conference of Student Chapters. A luncheon at the Tudor Arms Hotel, headquarters of the Conference, initiated the program. During the afternoon a symposium on "Civil Engineering in Defense" was presented by three members of the Case faculty—George E. Barnes, head of the civil engineering department, and Malcolm S. Douglas and George B. Earnest, assistant professors of civil engineering. Professor Barnes spoke on "Construction Under Priority Regulations," while the two latter discussed the results of aerial bombardment in England and protection from bombardment. A round-table discussion completed the program.

In the evening there was a joint banquet with the Cleveland Section. The speaker and guest of honor was David Dietz, science editor of the Scripps-Howard newspapers, who discussed the part that science and engineering are playing in the war against the Axis. A novel feature of the evening was the presentation of a "man-mile trophy" to the Chapter having the greatest number of men in attendance and the greatest number of miles of travel. The cup—presented to the Conference jointly by the Case School of Applied Science and the Case Student Chapter—will be a permanent rotating trophy. This year it went to Ohio Northern University, which had a representation of fourteen. The other schools represented were the Carnegie Institute of Technology, the University of Pittsburgh, Ohio State University, the University of Dayton, the University of Michigan, West Virginia University, Akron University, and the host Chapter. The attendance totaled 110.

Early Friday morning the group toured the civil engineering laboratories, members of the Case Chapter acting as guides. The remainder of the morning was devoted to the reading of student papers in the annual prize competition. First prize of $15 went to J. H. Elliott, of the University of Pittsburgh, for his paper on "Concrete Resistance to High Explosive Bombs," and second prize of $10 to Gilbert Nyerges, of the Case School, for a paper on "Skyscraper Construction." The prizes were donated by the Cleveland Section.

The afternoon program consisted of an inspection tour to points of civil engineering interest in and about Cleveland. This trip—which was arranged by George B. Sowers, Cleveland consultant, and Charles Smallwood and George F. Sowers, of the Case Chapter—was unique in that such tours are generally banned by the F.B.I. these days.

Metropolitan Travel Adviser

IN ITS EFFORTS to be of service to all members, the Society's staff at Headquarters frequently has the privilege of advising visitors to New York. Perhaps the most frequent opportunity is afforded by the engineer who has a few hours and wants to visit some particular point of engineering interest. Usually the necessary contact to make such a visit possible is right at hand.

With the onset of war, the number of visitors has greatly decreased—and at the same time the number of available engineering construction projects has decreased. But the service or the advice still is available and effective. It goes beyond the strictly technical, out into the field of amusements, general sightseeing, and all the minutiae of cosmopolitan city life. How do you get to the Music Hall? Where is Edgar Allen Poe's cottage? Museums, terminals, buildings, cathedrals, church services, and other activities are all grist for the mill.

A card index has been established. In a first classification of "General" appear such items as airports, apartment houses, buildings, and colleges—and so on through the alphabet. A further classification by areas lists matters of interest in lower Manhattan, midtown Manhattan, and others, including the "Vicinity of Manhattan." Thus a visitor may make for himself a profitable tour, all in a given part of town, should he so desire.

If it is a matter of entertainment, it is necessary to refer to some up-to-the-minute manual. A number of these are issued which give the current athletic, theatrical, and technical activities of the day, and copies are always at hand in the Reading Room at Society Headquarters. Maps are supplied which prevent the unwary stranger from getting lost in the complicated subway system. Or more likely, he may be directed by way of the open-top buses, from which the panorama of city life constantly unfolds.

On your next trip to New York it may not be practicable for the Society to be of help in arranging for your visit, but the chances are that you can be saved many a false move, and that your visit can, in addition, be made more profitable and more enjoyable. If you will call at Headquarters a sincere effort will be made to assist you. In any event, it will be a privilege to try.

Technological Institute Dedicated at Northwestern University

Notable among a number of recent improvements to educational facilities is the splendid new building housing the Technological Institute of Northwestern University at Evanston, Ill. This plant was dedicated with appropriate ceremonies on June 15 and 16. It represents an expenditure of some five million dollars.

The Technological Institute of Northwestern University, Evanston, Ill.

High lights among the events at the dedication were a number of industrial and educational conferences. Notable figures in the engineering world were present. Among those who had a share in the program were Charles F. Kettering, M. Am. Soc. C.E., and Henry T. Heald, M. Am. Soc. C.E.

As may be seen from the accompanying photograph, the new building consists essentially of a large central nucleus from which lead six wings, each devoted to a branch of science. The civil engineering department occupies one of these wings.

Approximately one million dollars worth of scientific equipment has been put into this splendid structure. Included is a 5,000,000-lb hydraulic testing machine for tension and compression as well as a 1,000,000-lb machine for cross bending. A hydraulic laboratory has also been installed. The technical courses operate on the cooperative plan, with alternating three-month periods of study and work.

At the dedication the Society was represented by Vice-President Charles B. Burdick.

Society Preparing New Illustrated Lectures

For many years the Society has maintained at Headquarters, a group of twenty-five illustrated lectures describing various engineering projects. These are primarily for the use of Student Chapters and are made available without charge, the Society paying the shipping charges both ways.

At the present time an effort is being made to add new material to this worth-while activity in behalf of civil engineering students. Many new lectures are being prepared on more recent projects. The Society gratefully acknowledges the generous cooperation of the following members who, though hard pressed in these busy times, have already offered to furnish data on the projects listed opposite their names:

Philip Harrington, Commissioner of Subways and Superhighways, City of Chicago	"Chicago Subways"
S. O. Harper, Chief Engineer, U.S. Bureau of Reclamation, Denver, Colo.	"All-American Canal"
Malcolm Elliot, Colonel, Corps of Engineers, Division Engineer, Upper Mississippi Valley Division, St. Louis, Mo.	"Canalization of the Upper Mississippi River"
E. L. Durkee, Resident Erection Engineer, Bethlehem Steel Company, Bethlehem, Pa.	"Rainbow Bridge at Niagara Falls"
William H. Trinkaus, Construction Engineer, Sanitary District of Chicago, Chicago, Ill.	"Chicago Sanitary Works"
W. W. DeBerard, City Engineer, Chicago, Ill.	"Bascule Bridges of Chicago"
Ole Singstad, Chief Engineer, New York City Tunnel Authority	"Queens Midtown Tunnel

Other new lectures are in prospect, and it is hoped that shortly this list will be considerably augmented, as acceptances are received from authors from whom cooperation has been requested. In addition to the lantern slide lectures, some of these projects will be illustrated by motion pictures.

Today the Society's first thoughts and efforts are directed toward the victorious prosecution of the war. It realizes, however, that future engineers are being prepared for future careers in the profession and that its efforts in their behalf are also valuable at this time.

New Officers for Military Engineers

At its recent elections, the Society of American Military Engineers chose new officers for the coming year, including several who are members of the American Society of Civil Engineers. Newly elected general officers include: president, Maj. Gen. Julian L. Schley, M. Am. Soc. C.E.; first vice-president, Col. Henry M. Waite, Hon. M. Am. Soc. C.E.; and second vice-president, Vice-Admiral R. R. Waesche.

General Schley's predecessors, still members of the Board, are Rear Admiral Ben Moreell and Col. J. Monroe Johnson, both Members of the Society. The Board of Directors also contains many members of the American Society of Civil Engineers. The following are included: Rear Admiral R. E. Bakenhus, Col. F. C. Jonah, Col. John Lansdale, Col. Herbert J. Wild, Frederick Hall Fowler, Col. E. S. Bres, Gano Dunn, Col. C. O. Sherrill, Lt. Col. T. B. Parker, Maj. Ernest B. Black, Rear Admiral L. O. Colbert, and Col. O. M. Leland.

Also honored by the Society of American Military Engineers was Lt. Col. Paul W. Thompson, Assoc. M. Am. Soc. C.E. Colonel Thompson received the Toulmin Medal in recognition of a number of articles he had written under the general heading of "Engineers in Battle," published in *The Military Engineer*.

Corps of Engineers Opens Three New Division Headquarters

Many members have dealings with the Corps of Engineers and will be interested in a recent redistribution of the work. Three new divisions have been established as follows: New England Division, 75 Federal Street, Boston, with Boston and Providence district offices; Middle Atlantic Division, 101 East Fayette Street, Baltimore, Md., with Baltimore, Norfolk, and Washington district offices; and Mountain Division, 36$^1/_2$ West Second, South, Salt Lake City, Utah, with Salt Lake City and Denver district offices.

In the February 1942 issue, page 111, a complete office set-up for the Corps of Engineers was given. In general, the district offices are maintained. However, a number of the division offices have been changed, including the following: Great Lakes Division, from

419 Federal Building, Cleveland, Ohio, to 332 South Michigan Avenue, Chicago, Ill.; Missouri River Division, from 1201 Davidson Building, 10 East 17th Street, Kansas City, Mo., to 19th and Douglas streets, Omaha, Nebr.; and South Atlantic Division, from Main and Laurel streets, Richmond, Va., to 50 Whitehall Street, Atlanta, Ga.

Otherwise the previous information is believed to hold good.

1942 Graduates Apply for Membership

It is a well recognized fact that the continued life and growth of the Society depend in large measure upon the addition of new members. Therefore, great interest attaches to the number of applications for membership received from recent graduates each year. Over 400 applications have already been received from civil engineering graduates of 1942. It is with some degree of pride that the Society announces receipt of applications from 100% of the graduates in civil engineering from the following schools:

University of Oklahoma
University of Utah
Bucknell University
Newark College of Engineering
Tulane University
University of Dayton
Rose Polytechnic Institute

It is sincerely hoped that many more, if not all, of our 121 Student Chapters will be included in this list as it expands in the near future. And congratulations to the seven listed here.

Engineers Continue Student Guidance Work in New York City's Schools

Student guidance by engineers for seniors in New York City high schools has been in effect for five years. A general statement of the organization, objectives, method of procedure, and description of the work of the New York Engineers' Committee on Student Guidance was made in the report of the committee for the school years 1940–1941 and also appears in "Civil Engineering" for June 1939 and July 1941. This subject matter is therefore not repeated here. The following paragraphs are excerpts from the Annual Report of the Committee for 1941–1942.

It is a great satisfaction to be able to report a successful year despite the difficulties that had to be overcome. Engineers serving on this committee are for the most part connected with companies whose work was greatly expanded by the war emergency and they have been working under pressure for a long period. Despite this they responded to their assignments to school meetings better than the officers of the committee expected.

A total of 28 group meetings were held at 25 high schools during the year. The total student attendance was 2,060 and the total committee attendance was 88. The committee attendance was smaller than in former years but was excellent considering the pressure under which engineers are working. In addition to the group meetings, a general assembly of students was addressed at each of three high schools. On March 18, Commissioner Walter D. Binger addressed an audience of a little more than 3,000 at Brooklyn Technical High School. On May 15, William H. Larkin addressed an audience of about 1,000 at New Utrecht High School, and on June 1, Dean Robert L. Sackett addressed about 1,000 at Flushing High School. On February 26, H. L. Shuldener addressed the Parent-Teachers Association and about 60 students at Stuyvesant High School.

The guidance department of each high school has been provided with one or more copies of "Engineering, A Career" and "Accredited Engineering Curricula in the United States," both publications of the Engineers' Council for Professional Development. The schools report that these publications are consulted by the students, and several hundred students have purchased copies of "Engineering, A Career" for their individual use.

The committee has received this year, as in other years, many letters of appreciation from high schools. Some student counselors say that this was done by request of the students themselves. The concensus of opinion of the counselors is that the work of the committee has been effective in influencing students to make a wise choice of their future careers. All members of the committee who attend these school meetings agree that these contacts with the students are inspiring.

Officers of the New York Engineers' Committee on Student Guidance for 1941–1942 were: Arthur G. Hayden, M. Am. Soc. C.E., chairman; William H. Larkin, vice-chairman; Zola G. Deutsch, secretary; and James M. Comly, treasurer.

The constituent committee for the American Society of Civil Engineers was made up of Arthur G. Hayden, chairman; E. Warren Bowden, Ray C. Brumfield, William W. Brush, Donald M. Burmister, Edward J. Cleary, Henry C. Codwise, Clarence W. Dunham, Elmer M. Fleming, William L. Hanavan, Shortridge Hardesty, Alfred Hedefine, Robert H. Jacobs, Theodore R. Kendall, Fred Lavis, John H. Myers, Glenn S. Reeves, Thorndike Saville, Homer R. Seely, and David L. Snader.

The other organizations represented by constituent committees are the American Institute of Chemical Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Mining and Metallurgical Engineers.

Leroy L. Hidinger Receives Marston Medal

It has been announced that this year's recipient of the Marston Medal is Leroy L. Hidinger, president of the Morgan Engineering Company, of Memphis, Tenn. This award, which was established by Iowa State College through the generosity of Anson Marston, Past-President and Honorary Member of the Society, is given annually to an engineering alumnus of Iowa State in recognition of engineering achievement.

In 1910 Mr. Hidinger and Arthur E. Morgan, M. Am. Soc. C.E., organized the Morgan Engineering Company, with offices in Memphis. Mr. Hidinger has been successively partner, vice-president, and since 1915 president of the company in charge of operations. In addition to the home office at Memphis, the company has operated branch offices in different parts of the country. A member of the Society since 1910, Mr. Hidinger in 1920 and 1921 served as a member of the committee that drafted the present Constitution of the Society. He was Director from 1936 to 1938.

Year's Report on Freeman Traveling Scholarship By H. G. Dewey, Jr.

The Society is in receipt of a splendid mimeographed final report on the year of work done by Haywood G. Dewey, Jr., Jun. Am. Soc. C.E., as holder of the Freeman Traveling Scholarship in Hydraulics for 1940–1941. Many excellent reports by Freeman Scholars have been received in years past, but it remained for Mr. Dewey to produce the most comprehensive and useful record. This will prove of value not only as a historical document but as a reference and guide for the future.

It will be remembered that Mr. Dewey elected to spend his year in studying American hydraulic laboratory practice, covering some of the major installations, not only laboratories but constructed projects throughout the country. His object was (1) to correlate the performance of model with prototype, (2) to obtain a better idea of the magnitude of prototype phenomena, which idea tends to be distorted by thinking in terms of the model, and (3) to study those features of hydraulic structures displaying an improper or inadequate design. Various types of model and field set-ups were investigated, including hydraulic structures and appurtenant works, hydraulic machinery, and rivers.

Among the particular subjects studied by Mr. Dewey were such developments in hydraulic research as efficient stilling pools for dissipating the energy of high-velocity flow at the toe of overfall dams and at the end of spillways; regulating valves free from cavitation; more economical and safer structures; more efficient hydraulic machinery; the explanation of pitting of boundary surfaces by cavitation; efficient improvement plans and flood control measures on rivers; the laws of transportation of sediment by flowing water, and the mechanism of fluid turbulence, just to mention a few. The report further covers in some detail the "Theory and Application of Hydraulic Models," "Hydraulic Model Tests," "Fundamental Research," and "Field Investigations."

Not a little of the value of this report is inherent in the fine illustrations, both diagrammatical and photographic, which cover testing as well as field installations. This presentation was made possible by the assistance of the Chief Engineer's Office of the Bureau of Reclamation, in the preparation of the report for publication. The result is a general picture of hydraulic research in the United States and many of the more important hydraulic installations. Some of the research involved is being incorporated into a paper on "Model-Prototype Comparisons of Hydraulic Structures," prepared by Mr. Dewey with Jacob E. Warnock, M. Am. Soc. C.E., and planned for inclusion in a forthcoming symposium on "Model and Prototype Conformity," to be published by the Society.

Also included in the report is a summary of Mr. Dewey's monthly records detailing his year of study. Finally, there is a financial statement for the year which certainly will be a valuable reference for similar projects in the future.

As no arrangements have been made for an immediate successor to Mr. Dewey as Freeman Traveling Scholar, his report will remain as the latest, until conditions again make it feasible to continue this worthy project, established through the keen insight and imagination of the late Past-President and Honorary Member, John R. Freeman. Copies of Mr. Dewey's report are on file at Headquarters. Practicing engineers as well as students of hydraulics may be interested in examining them as an aid in keeping abreast of current developments in this active engineering field.

Society Boasts Imposing List of "Oldest Members"

MEMBERSHIP in the Society for periods of sixty-four and sixty-three years, respectively, are the records of C. Frank Allen and Percival J. Roberts. Next comes George Hume Simpson, with a membership span of only one year less—sixty-two years. If these men are proud of their long and honorable connection with the Society, the reverse is certainly true—the Society is very proud of them. It is likewise proud of the many others whose span of membership dates back to 1890 or before. And there are a number who can boast such a record, as the following list shows.

These men have seen the Society membership grow from approximately thirteen hundred to its present total of over seventeen thousand eight hundred. What stories they can tell of the vast changes in engineering brought about by technological research and practice, as well as by changed social and economic conditions! Through all these changes the Society has forged ahead, taking the difficulties and the satisfactions both in its stride—thanks to the loyal support of members such as these.

Following is the list of those whose connection with the Society dates back to 1890 or before, complete as of June 15, 1942:

Allen, C. Frank, '78
Roberts, Percival J., '79
Simpson, George H., '80
Thackray, George E., '82
Breithaupt, William H., '84
Flad, Edward, '85
Kittredge, George W., '86
Barlow, J. Quincy, '86
Tratman, E. E. R., '86
Waddell, Montgomery, '86
Purdy, C. T. '87
Tuttle, A. S., '87
Darwin, H. G., '87
Andrews, Horace, '87
Hudson, John R., '87
Bell, Gilbert J., '87
Wada, Y., '87
Carroll, Eugene, '88
Dunlap, DeC., '88
Dennis, W. F., '88
Landor, Edward J., '88
Clark, W. G., '88
Tibballs, George A., '88
Tibballs, S. G., '88
Tompson, G. M., '88
Stevens, John F., '88
Fisher, Edwin A., '88
McCulloh, Walter, '88
Pratt, M. D., '88
Thomson, T. Kennard, '88
Bassett, C. P., '88
Pearl, James W., '89
French, James B., '89
Todd, Frank H., '89
Whittemore, W. F., '89
Erlandsen, Oscar, '89
Pierson, George S., '89
Buck, Waldo E., '89
Miller, Spencer, '89
Blakeley, George H., '89
Harwi, Solomon J., '89
Keith, H. C., '89
Miller, Rudolph P., '90
Connor, Edward H., '90
Ross, Elmer W., '90
Davison, George S., '90
McMeekin, Charles W., '90
Marstrand, Otto J., '90
Staniford, C. W., '90
Greiner, J. E., '90
Moses, John C., '90
Quimby, H. H., '90
Triest, W. G., '90
Cummings, R. A., '90
Stanford, H. R., '90
Jacoby, H. S., '90
Treadwell, Lee, '90
Davis, Chandler, '90

News of Local Sections

Scheduled Meetings

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:10 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Dallas Athletic Club on July 6, at 12:10 p.m.

Recent Activities

ALABAMA SECTION

War needs, from the construction of military and access roads to air-raid protection, were discussed at the spring meeting of the Alabama Section, which was held in Montgomery on May 15 and 16. The attendance of about a hundred included A. C. Polk, Director of the Society, and J. E. Jagger, Field Secretary. "The Highway Department's Place in the Defense Effort" was discussed by State Highway Director W. G. Pruett at the Friday afternoon technical session. Other members of the Department who spoke were Marvin Taylor, maintenance engineer; A. Reese Harvey, office engineer; and B. E. Higgins, state bridge maintenance engineer. Maj. J. F. Brawner, state director of public safety, gave a talk on the activities of the State Highway Patrol in wartime. Friday evening there was a dinner held jointly with the Montgomery Engineers' Club. The after-dinner speakers were Harry Hendon, chief engineer of Jefferson County, and L. H. Norris, professor of civil engineering at Alabama Polytechnic Institute. Both discussed the conference on protection from aerial bombardment that they attended in New York in January.

The Saturday morning program included talks by W. O. Dobbins, director of the State Planning Commission, and Houston Cole, executive director of the State Defense Council. The former spoke on "Housing, Works, and Facilities in War Activities," while Mr. Cole's subject was "Alabama State Defense Council Activities."

ARIZONA SECTION

On May 2 members of the Arizona Section gathered at Tucson for their spring meeting. A paper on "Arizona Highway Development" was read by W. R. Hutchins, state highway engineer. There were also talks by E. D. Gardner, of the U.S. Bureau of Mines, whose subject was "Strategic Minerals Program," and J. J. O'Dowd, who spoke on "Rationing in Wartime." Mr. O'Dowd is chairman of the Pima County Rationing Board. An interesting moving picture, entitled "MacArthur and the Bombing of Manila," concluded the technical program. At noon there was a joint luncheon with the Student Chapter at the University of Arizona. John Johnson, president of the Student Chapter, presided. Mr Johnson was also the recipient of the Section's prize of Junior membership in the Society. The afternoon was devoted to business discussion.

CENTRAL ILLINOIS SECTION

Annually the Central Illinois Section entertains the wives of members by reserving the May meeting as "Ladies' Day." This year the members of the Student Chapter at the University of Illinois requested that their meeting be combined with the ladies' festivities so that they would have an opportunity to meet the professional engineer informally. The feature of the occasion was the presentation of Junior membership in the Society to James A. Porter, Elwyn H. King, and A. N. May, the awards being made on the basis of "outstanding work and leadership in conducting the Student Chapter affairs." Later S. Johnson, expert mountain climber, gave an illustrated lecture that showed a series of trips among the major peaks of the West.

COLORADO SECTION

Members of the Student Chapters at the University of Colorado and Colorado State College were guests of the Section at a dinner meeting held in Denver on May 11. Winners of the Section's prizes of Junior membership in the Society were announced, the recipients being Murray Manley, of Colorado State College, and Charles Dwyer, of the University of Colorado. The award went to Mr. Manley for his paper on "The Seismograph and Its Use in the Petroleum Industry," while Mr. Dwyer's paper was entitled "Ground Water—and the Civil Engineer." The speaker and guest of honor was E. B. Black, President of the Society. Mr. Black spoke on the topic, "War Activities of the American Society of Civil Engineers," pointing out that engineering, like other professions, cannot carry on "Business as usual" but must throw its talent and experience into the war effort.

CONNECTICUT SECTION

On May 20 members of the Student Chapter at the University of Connecticut were dinner guests of the Connecticut Section. Following dinner it was announced that the Section's prizes of Junior membership in the Society go to Arthur B. Harding, Jr., of Yale University, and Malcolm G. Andrews, of the University of Connecticut. The technical program consisted of a talk on "Engineering Aspects of Civilian Defense," given by Theodore Crane, professor of architectural engineering at Yale.

KANSAS CITY SECTION

A varied program had been arranged for the April dinner meeting of the Kansas City Section. First, Michael D. Konomas, attorney and Greek Consular Agent for the Kansas City district, spoke on "Subversive Activities and Americanism." He was followed by a representative of the Truscon Steel Company, who showed a technicolor film depicting the use of light steel frames in the construction of Navy barracks. The presentation of a series of lantern slides, accompanied by phonograph description, on the use of Ferro-Glass in the construction of bomber plants, concluded the program. The slides were also shown through the courtesy of the Truscon Steel Company.

KENTUCKY SECTION

On May 15 the Kentucky Section met jointly with the Student Chapters at the University of Louisville and the University of Kentucky at Lexington. During the business meeting the Section awards of Junior membership in the Society were presented to Earl Schaaf, of the University of Louisville, and A. J. Spare, of the University of Kentucky. The meeting was then turned over to Mr. Spare, president of the University of Kentucky Chapter, who introduced the speakers competing in the Section contest for prize papers. Six students participated, and the prizes were awarded as follows: First prize of $15 to John D. Hancock, of the University of Louisville, for his paper on bomb shelters; second prize of $10 to Earl Schaaf, of the University of Louisville, for a paper on "The Problem of Parking Facilities"; and third prize of $5 to C. E. Baierlein, of the University of Kentucky, for his paper on "Strength of Concrete by Vibrations."

LEHIGH VALLEY SECTION

The Section had two joint meetings in April—on the 10th with the Lehigh University and Lafayette College Student Chapters, and on the 20th with the Engineers' Club of the Lehigh Valley. The speaker at the first of these meetings was W. N. Brown, who discussed the work of the U.S. Coast and Geodetic Survey, while later in the month Hallet Abend spoke on the subject, "Ramparts of the Pacific." Mr. Abend had just returned from a 38,000-mile trip by air throughout the Pacific area. As chief Far Eastern correspondent for the *New York Times*, he has been in the Orient for fifteen years, so his talk was an acute and timely analysis of the whole Far Eastern situation.

LOS ANGELES SECTION

The Los Angeles Section held its May meeting on the campus of the California Institute of Technology, where the members were guests of the Student Chapter. The group was taken on a tour of the various laboratories and experimental projects, and after dinner heard three speakers. These were Brooks T. Morris, of the staff of the Institute, who gave an illustrated lecture on "Scour Control for Hydraulic Structures"; Cecil E. P. Jeffreys, research assistant in biology, who talked on "Poison Gases and How to Combat Them"; and Dr. Seth Nicholson, astronomer for the Mount Wilson Observatory, whose subject was "Sunspots and Their Engineering Significance."

MARYLAND SECTION

At the May meeting—held in Baltimore on the 21st—E. W. James, chief of the Inter-American Regional Office of the Public Roads Administration, discussed the history of the Pan-American Highway in Central America. Mr. James explained some of the difficulties of location and construction, and showed motion pictures that he had made on parts of the highway in Mexico, Guatemala, and Salvador. The Section's prizes of Junior membership in the Society were presented to Gordon P. Fisher, of The Johns Hopkins University, and Fred Shulman, of the University of Maryland, and each recipient made a brief speech of thanks. During the business session Prof. Thomas F. Comber, Jr., was elected president of the Section to fill the vacancy caused by the resignation of Capt. E. M. Killough, who has been called to active duty.

METROPOLITAN SECTION

The Metropolitan Section's final meeting of the season was held at Columbia University on May 20. The technical program consisted of a talk by Adolph J. Ackerman on "Construction Planning." Mr. Ackerman, who is director of engineering for the Dravo Corporation, in Pittsburgh, Pa., discussed in detail the planning of a number of major construction projects, including several of the TVA and Western dams. The lecture was illustrated with a series of construction scenes, charts, graphs, accounting forms, and the like, which made the talk very effective. A special feature of the occasion was the award of the Robert Ridgway Student Chapter Prizes to the outstanding senior in each of the Chapters in the Metropolitan area. The winners were Stanley William Beer, of Brooklyn Polytechnic Institute; David Stewart Donald, of Newark College of Engineering; James Francis Fawls, of Manhattan College; George Gordon, of Rutgers University; John Carl Hagedorn, of Cooper Union; John Francis Stolz, of the College of the City of New York; and Arthur Tauscher, of New York University. During the business session Thorndike Saville was elected president, and William M. Griffin, vice-president. William J. Shea will continue as secretary. Following the meeting, the civil engineering laboratories were inspected.

MOHAWK-HUDSON SECTION

On May 12 the Mohawk-Hudson Section held its final meeting of the season at Rensselaer Polytechnic Institute at Troy, N.Y. A talk on "Engineering Markets" was the feature of the occasion. This was given by Miss Elsie Eaves, manager of the Business News Dapartment and director of Market Surveys for several of the McGraw-Hill publications. As it was the first time the Section had entertained a lady civil engineer the wives of the members were invited to attend, and the meeting proved very enjoyable.

NEW MEXICO SECTION

Members and guests of the New Mexico Section met in Albuquerque on May 13. The group first visited the greenhouses of Dr. Gekler near Atrisco. They were shown through the plant, and Dr. Gekler discussed his development of commercial hydrophonics. The group then adjourned to the University of New Mexico, where several new officers were elected to replace those recently called away for duty with the Armed Services or for war work. These new officers are W. E. Strohm, president; John H. Bliss, first vice-president; and Stanley Phillippi, second vice-president. The technical program consisted of a talk by Col. William Powell, of the New Mexico State Guard, who spoke on the functions and organization of civilian defense.

PHILADELPHIA SECTION

The problem of adapting concrete design to present-day demands was discussed by René L. Bertin at the May meeting of the Section. Mr. Bertin, who is chief engineer of the White Construction Company, of New York City, stated that recent orders of the War and Navy Departments to avoid the use of structural steel and to reduce to a minimum the use of reinforcing steel afford the designer a unique opportunity to use his ingenuity and skill in solving structural problems. His suggestions for saving included the use of plain concrete and masonry in foundation work on footings and piling, the use of gravity sections in the construction of bulkheads and retaining walls, and the substitution of reinforced concrete for structural steel in long-span, low-type structures such as hangars and airplane assembly plants. At the conclusion of Mr. Bertin's talk, Charles Haydock spoke briefly in behalf of the Philadelphia

Council on Civilian Defense. Assistant Secretary James H. Allen then discussed the shortage of water and asked the cooperation of the membership in the conservation of this commodity.

Sacramento Section

As usual members of the Sacramento Section have been enjoying weekly luncheon meetings. The list of those addressing the May gatherings includes Rolando McCraney, of the Production Division of the War Production Board, who explained the set-up and objectives of this important emergency agency; Dan L. Lindsley, of the J. H. Baxter Company, who spoke on "Functional Wood Preservation"; and Dr. Willis Miller, representative of the California State Planning Board, whose subject was "A Mapping Plan for California." The meeting held on the 26th was unique in that the program was a duplication of the May 21st session of the Speakers Club of the Section. The program was arranged by Fred J. Grumm, who acted as toastmaster. Mason Johnston, the Club's instructor, concluded the session with suitable comment. There was a special meeting on the 25th to hear Howard F. Peckworth speak on "Employer-Employee Relationships."

Tacoma Section

Members of the Seattle and Tacoma Sections had their annual get-together on May 25. President William D. Shannon, of the Seattle Section, presented a short talk on the subject of the country's need of various critical materials and urged the cooperation of all in the conservation of these materials. Mr. Shannon is district manager of the War Production Board in the Seattle area. Following his remarks Lothrop Crosby, president of the Tacoma Section, pledged the whole-hearted support of the Tacoma membership. When dinner was over the Seattle Section presented a program of moving pictures, including a color film on copper mining and development work of the Utah Copper Company near Bingham, Utah, and War Production Board films on the manufacture of tanks and medium bombers.

Toledo Section

Under the sponsorship and guidance of the Toledo Section, civil engineering students at the University of Toledo have recently organized the University of Toledo Society of Civil Engineers. At the first meeting, on March 25, the constitution was submitted for approval of the membership and the following officers were elected: Clarence Merritt, president; Donald Ellis, vice-president; Richard Hunter, secretary; and John Raggon, treasurer. Since the organization meeting several business sessions have been held, one with the Toledo Section. At this dinner meeting Harold Stepleton, president of the Toledo Section, addressed the group on "The Code of Ethics of the American Society of Civil Engineers." Under the leadership of Prof. L. M. Friedrich, the young men have enthusiastically established this new organization. For their success they will have the continuing interest of the Society and the Section.

Utah Section

The Student Chapter at the University of Utah joined the Utah Section for a dinner meeting in Salt Lake City on May 6. Richard R. Lyman reviewed the recent experiences, at the hands of bandits, of L. M. Winsor and his engineering party in Iran. Mr. Winsor was president of the Section last year and is now doing consulting work for the government of Iran. The meeting was then turned over to the students and two of them—Joseph J. Brubaker and Keith T. Fowler—spoke. The former gave an illustrated talk entitled "Brief of a Thesis on Photoelasticity," while Mr. Fowler's subject was "Impressions of a Young Engineer in His First Employment."

West Virginia Section

On May 11 members of the Section and of the Morgantown Chapter of the West Virginia Society of Professional Engineers met for dinner and a joint technical session. The principal speaker was Capt. Richard P. Brown, of the Plant Security Division of the Pittsburgh Ordinance Department, who discussed "Industrial Plant Protection in Wartime." Captain Brown displayed an incendiary bomb and discussed methods of protection against such projectiles as well as larger bombs. An enthusiastic open forum followed his talk.

Appointments of Society Representatives

Charles B. Burdick, M. Am. Soc. C.E., has been appointed one of the Society's representatives on the Washington Award Commission for the term, June 1942–June 1944.

Edward P. Hamilton, Assoc. M. Am. Soc. C.E., has been appointed one of the Society's representatives on the Engineering Societies Library Board to fill the unexpired term of Thorndike Saville, which would have terminated in October had he not found it necessary to resign. In addition to filling the unexpired term, Mr. Hamilton will continue as representative for the three-year term beginning in October.

Fred Lavis, L. M. Lawson, and **Charles M. Upham**, Members Am. Soc. C.E., have been appointed to represent the Society on one of the subcommittees of the newly organized Joint Conference Committee to establish ways and means for better relationships with the Latin-American countries.

William H. Mueser, M. Am. Soc. C.E., has been appointed to fill the vacancy in the chairmanship of the Building Code Requirements Subcommittee on Excavations and Foundations A56, caused by the resignation of Col. Carlton S. Proctor to accept active duty with the Corps of Engineers.

J. P. H. Perry, M. Am. Soc. C.E., has been reappointed one of the Society's representatives on the Board of Trustees of United Engineering Trustees, Inc., for the four-year term, October 1942–October 1946.

Frank A. Russell, M. Am. Soc. C.E., was appointed the Society's delegate to the fiftieth annual meeting of the Society for the Promotion of Engineering Education, held in New York City, June 27–29, 1942.

E. M. T. Ryder, M. Am. Soc. C.E., has been reappointed one of the Society's representatives on the Engineering Foundation Board for the four-year term, beginning in October.

Charles H. Stevens, M. Am. Soc. C.E., represented the Society at the fifty-sixth annual commencement exercises of Temple University, which were held in Philadelphia, Pa., on June 11.

Harold E. Wessman, M. Am. Soc. C.E., has been reappointed the Society's representative on the Research Procedure Committee of Engineering Foundation for the one-year term beginning in October 1942.

Student Chapter Notes

Iowa State College

The Iowa State College Chapter reports the close of a very enjoyable year. At the final meeting L. P. Drew, bridge engineer for the Union Pacific Railroad, discussed the computation of stresses in bridges designed to carry the new engines. The guest of honor and speaker at the April meeting was Anson Marston, dean emeritus of the engineering college and Past-President and Honorary Member of the Society. Dean Marston chose for his subject, "War and the Engineer." Others who spoke were Dean T. R. Agg, former Director of the Society; A. H. Fuller, professor of civil engineering; Maurice Miller, president of the Iowa Section; and Mark Morris, Contact Member for the Chapter. Another end-of-the-semester event was the annual Engineering Open House, in which the Chapter participated.

Twelve members of the Chapter went to Madison, Wis., for the Midwest Conference of Student Chapters. Although the group had to travel 300 miles, it had the largest delegation there.

Washington University

On May 25 the Washington University Chapter was host to the St. Louis Section. The attendance of about sixty included the fathers of most of the senior students. Following dinner, which was served in one of the student dining rooms, several of the senior members gave talks on their thesis projects. Later the group visited the civil engineering laboratory, where the research projects were explained. Principal interest was in the three new Southwark-Emery testing machines and the Soil Testing Laboratory.

ITEMS OF INTEREST

About Engineers and Engineering

CIVIL ENGINEERING for August

SELECTION and compaction of soil for the Kentucky Dam, farthest downstream of all the TVA projects, will be described by M. N. Sinacori in the August issue. The control of the density of the material in place, and other features of this interesting work, will be explained and illustrated in his article.

The belief that increasingly heavy street traffic will follow the present emergency has given traffic engineers a problem to consider which might well be included in their advance planning programs. E. E. East, chief engineer of the Automobile Club of Southern California, discusses this question in a paper entitled "The Los Angeles Street Traffic Problem." This analysis of the results of inadequate parking facilities shows the vital need for finding a solution for the whole parking situation in our cities.

One of the largest projects of its kind to be undertaken in recent years is the Delaware system to augment the water supply of New York City. Construction of the Delaware Aqueduct, and particularly of Merriman Dam, are described by Roger W. Armstrong, Deputy Chief Engineer of the city's Board of Water Supply. Work on the dam is in progress and the tunnel construction is almost completed.

In addition, a paper by J. W. Johnson, of the U.S. Soil Conservation Service, on reservoir sedimentation, is expected to appear in the August number. He presents the results of investigations at Lake Issaqueena, South Carolina, as to the possibility of retarding the rate of reservoir silting. He gives conclusions drawn from the determination of underflow characteristics, and the results of controlled venting.

Improvisation by field highway engineers had yielded some interesting results, as given in the article by Fred Burkett of the Texas State Highway Department. The question of adapting highway construction and maintenance to the needs of the hour has called forth the ingenuity of these engineers. Theirs is the responsibility of providing unrestricted arteries for the emergency transportation of men and materials—a responsibility shared, of course, by their confreres in other states.

Members Awarded Honorary Degrees

EACH year at commencement time honorary degrees are awarded certain engineers who have made notable contributions to the profession. With engineers playing an increasingly important role in the war effort it is fitting that an unusual number of Society members should have been thus honored during the past commencement season. In addition to the following list, there may be others of whom the Society has not heard.

S. C. HOLLISTER, Doctor of Engineering, Stevens Institute.

REAR ADMIRAL BEN MOREELL, Doctor of Engineering, Washington University (St. Louis, Mo.).

HARRY S. ROGERS, Doctor of Laws, University of Wyoming.

JOSEPH G. SHRYOCK, Doctor of Science in Engineering, Pennsylvania Military College.

LT. GEN. BREHON B. SOMERVELL, Doctor of Military Science, Pennsylvania Military College.

ARTHUR S. TUTTLE, Doctor of Engineering, Rensselaer Polytechnic Institute.

WILBUR M. WILSON, Doctor of Engineering, Iowa State College.

War Production Board Issues General Directive for War-Time Construction

TO MAKE AVAILABLE all possible material and effort for immediate war production, the War Production Board has outlined the principles governing wartime construction as follows:

1. In order that the consumption of materials and equipment by construction activities shall not impede the production of combat supplies and equipment, it is essential that all construction, whether financed by Government or other funds, be reduced to the absolute minimum necessary for the war effort. This applies also to construction essential for vital civilian needs.

2. Reduction in the consumption of materials and equipment by construction operations can be achieved either by the elimination of non-essential projects or parts thereof, by deferring projects not needed immediately, or by appropriate changes in design and construction methods which will favor the use of those materials which are most plentiful and which will interfere least with the production of combat material.

3. In order to establish effective measures for the control of construction, the following general policies have been established by the War Production Board, in consultation with the War and Navy Departments.

4. Before any construction project can proceed, it must be acted upon affirmatively by some agency of the Federal Government or by its duly authorized representative. No project will be approved for construction unless it is found, by responsible authority, to meet the following criteria:

a. It is essential for the war effort.

b. Postponement of construction would be detrimental to the war effort.

c. It is not practicable to rent or convert existing facilities for the purpose.

d. The construction will not result in duplication or unnecessary expansion of existing plants or facilities now under construction or about to be constructed.

e. All possible economies have been made in the project, resulting in deletion of all non-essential items and parts.

f. The structure of the project has been designed of the simplest type, just sufficient to meet the minimum requirements. See paragraphs 5 and 6 also.

g. The answers to the following questions relating to conditions at the proposed site are all affirmative to the extent that they are pertinent:

(1) Are there sufficient labor and materials available to build it?

(2) Will adequate public utilities be available without costly extensions?

(3) Will transportation be available to serve it?

(4) Will labor be available to man it? (Are housing and other community facilities adequate?)

(5) Will machine tools and other equipment be available to equip it?

(6) Will raw materials be available to operate it?

(7) Can the manufactured product be used at once—or stored until needed?

5. *Priority of materials.* In general all construction shall be of the cheapest, temporary character with structural stability only sufficient to meet the needs of the service which the structure is intended to fulfill during the period of its contemplated war use. Ordinarily, wood frame construction is preferable to reinforced concrete, and reinforced concrete is preferred to steel. However, the guiding principle should always be to utilize those materials which are most plentiful and which, in the ultimate analysis, will cause the least interference with the production of combat material and the utilization of transportation and power.

6. Mechanical and electrical features shall be reduced to bare essentials. Air conditioning may only be used where manufacturing processes make its use essential and not for the comfort of or to increase efficiency of personnel. Electrical systems shall be of the simplest designs.

7. Construction materials and the end products, the use of which is prohibited by the Army and Navy Munitions Board directive, "List of Prohibited Items for Construction Work," dated April 1, 1942 [obtainable from the Office of Emergency Management, Division of Information], and revisions thereof, shall not be specified, purchased, or used except under special waiver issued by competent authority as provided for.

8. *Enforcement.* Each department having cognizance of construction work

will require its subordinate activities to comply strictly with the foregoing general policies and any extensions thereof issued by proper authority. Each department shall arrange for frequent and adequate spot checks of its projects to make sure that all subordinate agencies of the department concerned are rigorously conforming to the established policies. Furthermore, violations of those policies must be followed by proper disciplinary action and the imposition of suitable penalties.

9. It should be made clear to all concerned that these general policies should govern not only direct construction for the War and Navy Departments but also other construction financed directly or indirectly with Government funds, and all private construction. The evasion of the requirements of the general policies by manufacturers or other parties will result in the imposition of penalties.

10. The War Production Board, the Army, and the Navy shall take immediate steps to effectuate in detail this directive. It is particularly important that any governmental agency which has contact with or control of privately owned expansions see to it that no violations of this directive occur.

May 20, 1942

N. G. Neare's Column

Conducted by

R. Robinson Rowe, M. Am. Soc. C.E.

"I thot," began Professor Neare, "that our problem in bovine husbandry would entice some Agricultural Engineers to our meeting tonite. But since War Time has permitted three lactations a day, they will be delayed by the twilight milking. The cows are so bossy they can't sneak early.

"You remember the 4-part grazing problem. Do I hear an answer to the first: how large an area could two equal cows graze at constant rate if tethered to each other by a 100-ft rope threaded thru a knothole in a straight fence?"

"Not hard," answered Cal Klater. "While Lulu had less than 50 ft of rope, she could graze a semicircle with area $1{,}250\pi$. When Lulu took more than 50 ft, she would be limited to an area equal to that grazed by Moomoo with less than 50 ft—again $1{,}250\pi$. So the entire area grazed would be $5{,}000\pi$ sq ft."

"Incidentally," added our Life Member, "Lulu and Moomoo could keep the rope taut. With eyes for symmetry, the area grazed would be in the form of two Gothic cusps bounded by four quadrant arcs—that in the first quadrant having the polar equation $2\rho\phi = \pi(100-\rho)$. As the cusps have esthetic application, I have sketched them for you (Fig. 1)."

"And I'll extend one arc with dash lines," said the Professor, "to show that it is a spiral—somewhat hyperbolic, but distinct enuf to bear a name of its own, the 'bovine spiral.' Now suppose Moomoo were replaced by a heifer with only half the appetite of Lulu."

"No difference," interrupted Cal. "When the heifer had less than $^1/_3$ of the rope, she would graze $^1/_9$ of the 100-ft semicircle and Lulu $^2/_9$. When Lulu had less than $^2/_3$ of the rope, she would graze $^4/_9$ of the semicircle and the heifer $^2/_9$. All of which adds to $5{,}000\pi$ sq ft again."

"Just so," agreed the Professor. "The second sketch (Fig. 2) should make it clear. For any ratio of grazing rates, k, and rope length, R, the first quadrant arc will be given by

$$2\rho\phi = k\pi(R-\rho)$$

and the total area will be $^1/_2\pi R^2$. Next, if a single post replaces the fence?"

"Two cows will graze as before. But in the last case, the cow can graze on the heifer's side and increase the available pasturage to $6{,}667\pi$ sq ft."

"And generally the area is $\dfrac{\pi R^2}{1+k}$ and the rope can't be kept taut unless $k = 1$," concluded the Professor.

"For a new problem I'll have to reveal a little of a secret plan of our Sappers From 3 Allied bases—designated only as Shangri La, Shangri Lo, and Shangri Lum—tunnels are being driven straight thru the earth to Tokyo's foundations. Tunnel lengths are 1,000, 2,000, and 3,000 miles, respectively. Frictionless projectiles are to be dispatched by gravity alone so as to reach the objective simultaneously, blasting the village off the island. How should the dispatching be timed? If any of you care to be precise, consider the Earth as a sphere of constant density, with $R = 3{,}959$ miles, and $g = 0.006088$ miles per sec^2 at the surface."

(Cal Klater is regular Richard Jenney. The Life Member is David E. Hughes. He, Weston Gavett, and George T. Dean solved three parts. The others couldn't handle the heifer.)

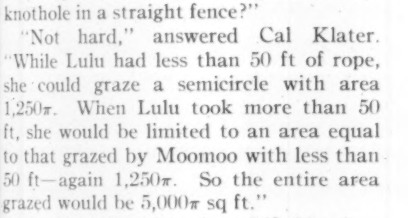


Fig 1

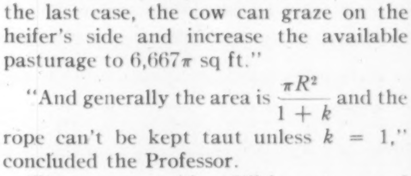


Fig. 2

Available Clay Sewer Pipe Now Includes Extra-Strength Type

Newly off the presses of the U.S. Printing Office are completely revised Federal Purchase Specifications for vitrified clay sewer pipe, augmented to include standards for a new and widely applicable strength classification of this material. Extra-strength clay sewer pipe, the new classification, is designated for installation in locations subject to abnormal trench loadings. It has been successfully used for such cases over more than five years in highway, airport, and sewer work throughout the Eastern United States.

In the revised specifications, the term "standard pipe" appears as a new general name for the class of pipe commonly known as double strength. At the beginning of the clay sewer pipe manufacturing industry, almost a century ago, most pipe was manufactured to meet a dimension schedule known as "Manufacturers' Standard." Pipe of this type has been generally called "single-strength" pipe. Later, specifications provided for heavier, better, and stronger pipe to meet increasingly severe service, known as "double strength" in contrast with the lighter Manufacturers' Standard. Now to meet even more severe service, "extra-strength" pipe, a still stronger classification of pipe, has been adopted.

Extra-strength pipe up to and including 24 in. in diameter under the new specifications meets minimum strength tests of $2{,}200-D$ (more than twice that for double-strength pipe). This formula gives the minimum strength, or load per lin ft, in terms of D, the diameter in feet.

This strength increase is brought about by improved manufacturing processes and by an increase of wall thicknesses of at least 25% above the thicknesses for double-strength pipe. To permit the direct interconnection of extra-strength and double-strength pipe without special joint construction, at crossings beneath heavy-duty roads, railroads, or airplane runways, the dimensions of extra-strength pipe are fixed so that spigots and sockets of both standard and extra-strength pipe are the same for corresponding pipe sizes. This results in uniform annular spaces where double-strength and extra-strength pipe are jointed together. Correspondence of spigot and socket diameters for the different classes is obtained by holding the outside diameters of double-strength and extra-strength pipe to the same dimensions for corresponding sizes. This permits the manufacture of either class of pipe with the same equipment. However, the net interior diameter of extra-strength pipe is somewhat less than for the corresponding size of standard pipe.

Thus, some extra work is required in computing the hydraulic capacity of extra-strength pipe as obtained from tables for other classes of the same nominal diameter. But benefits of much greater value and importance are obtained: first, in the advantage of uniform jointing between the two pipe classes, and second, in providing for manufacture of extra-strength pipe in every existing pipe plant, at once, without in any way decreasing vitally needed stocks of critical metals. The government and the clay pipe industry, in fixing on outside diameter as the base for other dimensions, are in line with the practice in dimensioning pipes and tubes made of other materials.

Extra-strength clay pipe is available for the war effort because no metals or critical materials are needed for its manufacture. Copies of the new specifications may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., at five cents a copy.

This information has been furnished by Benjamin Eisner, M. Am. Soc. C.E., chief engineer, Clay Sewer Pipe Association, Inc.

Benjamin Franklin Speaks for Today

IN THESE TIMES of our country's danger most of us are asking ourselves how best to use our influence to help the all-out war effort. Whether engaged in actual war production or not, there is one common contribution all can make—that is, assisting to build and maintain American morale. And this is no small contribution.

National morale depends to no slight degree on the fervor and admiration with which the people regard their national heroes and practice the virtues for which they stand. Benjamin Franklin for many reasons is a hero worthy of admiration and emulation today. Many of his statements sound as though they were written with the present emergency in mind. Take, for example, his philosophy about taxes. Evidently in his day, as in ours, the public looked with alarm on the rising levies. He wrote:

"Taxes are indeed very heavy, and if those laid on by the government were the only one we had to pay, we might the more easily discharge them; but we have many others, and much more grievous to some of us. We are taxed twice as much by our Idleness, three times as much by our Pride, and four times as much by our Folly; and from these taxes the commissioners cannot ease or deliver us by allowing an abatement."

"Be industrious and free; be frugal and free," he said. And it has a modern ring.

Particularly inspiring is the following which, though written to apply to the Revolution, certainly might as well have been dated today:

"The eyes of Christendom are upon us, and our honor as a people is become a matter of utmost consequence to be taken care of. If we give up our rights in this contest, a century to come will not restore us to the opinion of the world; we shall be stamped with the character of . . . poltroons and fools. . . . Present inconveniences are therefore to be borne with fortitude, and better times expected."

The National Committee to Signalize Benjamin Franklin's Continuing Contribution to American Civilization has prepared and is distributing without charge to interested individuals and groups background information relating to Franklin's activities in some of his many and varied fields of endeavor. It has also available a series of activities programs for the use of patriotic and civic organizations, schools and youth groups, leaders of industry and business, and colleges. Any of this material may be secured on request by writing to the Committee, at Benjamin Franklin Parkway and 20th Street, Philadelphia, Pa.

Rules for Kimbrough Medal Announced by American Institute of Steel Construction

UNDER THE auspices of the American Institute of Steel Construction, the J. Lloyd Kimbrough Medal is awarded from time to time. This gold medal is "reserved for and bestowed upon such persons as, in the judgment of the Board of Directors of the Institute, may have performed a marked service to the industry in design, construction, or the expanded uses of structural steel." First award of the medal was made to Robert Moses, Commissioner of Parks of New York City, as noted in the December 1941 issue.

The Institute's Committee on Medals and Awards, under Clyde MacCornack, M. Am. Soc. C.E., as chairman, has promulgated certain regulations to be observed in making the award. Among these rules are the following:

> "This award is reserved for special distinction and not necessarily made periodically.
>
> "The selection of recipients worthy of this award is in no way made a process of elimination by formal competition.
>
> "The Committee makes a survey at least once a year to determine whether, in the judgment of the Committee, there are persons available for consideration.
>
> "It is not the purpose of this survey to fix upon any individual, but merely to determine if, in the judgment of the Committee, there are one or more individuals worthy of consideration."

Communications regarding the J. Lloyd Kimbrough Medal may properly be addressed to the secretary of the Institute at 101 Park Avenue, New York, N.Y.

Slips of the Pen

ENGINEERING literature has been enlivened from time to time by linguistic slips. Some of these have caused the publication of serious tomes to be remembered principally for their unfortunate choice of word or metaphor. At times confusing but always amusing, the author's misfortune was not necessarily the reader's, who could doubtless appreciate this unwitting turn to the lighter vein. A few choice phrases, gathered from a variety of sources and over a number of years, are reproduced here:

"In neither the case of an embankment, built up from the bottom, nor an excavation, carried down from the top, do these facts remain strictly true."

"Every advantage was in favor of the scheme."

"I know that the cinder flooring was disintegrated by the heat of my personal observation."

"There was a down grade to every stream."

"The water supply of. . . . . . is pumped and sold entirely by meter."

"Occasionally there would be an oasis in this sea of antediluvian mud."

"Without the assistance of a helper."

"The elevation of the H.I."

"Flood damage was frequent and considerable, while the numerous water-power plants suffered very greatly from low water."

"Twice or more water gas is made in the United States than coal gas."

"Mr. M. has accomplished a large step forward in two directions, that of tunneling through soft ground, and bracing deep trenches."

"I never, in over thirty years' acquaintance, knew him to decline to do a thing because it was not right."

"A 10-ft pressure tunnel made of steel and surrounded on the outside with concrete and lined on the inside with a mortar lining."

"It was divided into two almost exactly equal halves."

"A spherical point of infinitely small radius."

"This paper appeals to me as an important milestone marking an epoch in the history of electric traction."

"This paper marks a long step in the halting program toward the successful solution of problems pertaining to lateral earth pressure."

"It was then considered advisable to make use of these piles by capping them with concrete footings."

"Past flood heights represent the worst to come."

"The rapid shifting of population is causing the doubling of children in suburban schools."

"In 1924–1925 some 6,315 loads of refuse were thus disposed of, and some 8,700 odd animals and birds destroyed ranging from horses and cattle to snakes."

"The cans, without covers, may be rested on the truck to avoid hauling so much empty space, thus consolidating the load."

"Denver, nestling like a jewel on the bosom of the backbone of the Rockies."

Brief Notes

A SUMMER COURSE in photoelasticity is being offered July 27–August 7 by the Department of Mechanical Engineering, Massachusetts Institute of Technology. Applications should be addressed to the Director of Admissions, M.I.T., Cambridge, Mass., and other inquiries to Dr. W. M. Murray, Room 1-321, M.I.T.

* * * *

THE University of Chicago Press announces that the five papers on clay materials and their practical application—presented at the fiftieth anniversary celebration of the University in September 1941—have been published in the May issue of the *Journal of Geology* and are now available in reprint form. The price is $1, and copies may be obtained from the University of Chicago Press, 5750 Ellis Avenue, Chicago.

* * * *

Announcement has been made of a new edition (the fourth) of the Handbook of Scientific and Technical Societies and Institutions of the United States and Canada. This 389-page handbook gives the president and secretary of the organization, the history, membership, meetings, research funds, and serial publications. Cloth-bound copies are for sale for $4 by the National Research Council, 2101 Constitution Avenue, Washington, D.C.

NEWS OF ENGINEERS

Personal Items About Society Members

E. L. Chandler has been granted a leave of absence from the Chattanooga (Tenn.) Flood Protection District, of which he is chief engineer, in order to serve as project engineer for the Charles T. Main Company at Wilmington, Del., on dry-dock facilities for the U.S. Navy.

Ralph C. Brown was recently promoted from the rank of captain in the Quartermaster Corps of the U.S. Army to that of major. For the past year he has been on construction duty at Niagara Falls, N.Y.

Herman H. Block has left for San Juan, Puerto Rico, where he will become connected with a construction company building naval and air bases in the West Indies. Mr. Block was formerly in the Project Planning Division of the TVA.

Rex A. Elder, of Corvallis, Ore., is now a member of the TVA hydraulic laboratory staff at Norris, Tenn.

E. L. Shoemaker has been called to active duty in the U.S. Corps of Engineers with the rank of major. He is stationed in the Procurement Section of the Philaphia (Pa.) District Engineer Office. Until recently Major Shoemaker was chief engineer of the Philadelphia firm, Warner Company.

Gerard H. Matthes has been made director of the U.S. Waterways Experiment Station, with headquarters at Vicksburg, Miss. He still retains his title as head engineer of the Mississippi River Commission.

M. C. Neel recently severed his connection as structural engineer for the Wisconsin Industrial Commission in order to accept the position of chief of the engineering staff of the Rilco Laminated Products, Inc., at St. Paul, Minn.

Clarence A. Willson, until lately structural engineer in the State Architect's Office at Madison, Wis., is now senior structural engineer in the Bureau of Industrial Conservation of the War Production Board, Washington, D.C.

E. B. Myott, formerly senior engineer for Fay, Spofford and Thorndike, of Boston, Mass., has reported for active duty in the Corps of Engineers, U.S. Army. He has the rank of major.

Thomas E. Collins, city engineer of Elizabeth, N.J., has been appointed a member of the New Jersey State Planning Board.

Wharton Green is now associate engineer for Jay Downer on the design and supervision of construction of Idlewild, New York City's newest and largest airport now being constructed on Jamaica Bay.

Bruce G. Johnston has been granted a leave of absence as associate director of the Fritz Engineering Laboratory at Bethlehem, Pa., in order to work in the Bureau of Yards and Docks, Washington, D.C. Mr. Johnston is serving in a civilian capacity.

Hugh J. Davis recently resigned as instructor in the engineering school at Southern Methodist University in order to accept an engineering post with the Tennessee Valley Authority.

Harry Hodgman has retired as senior engineer in the U.S. Engineer Office at Los Angeles, Calif., after more than forty-eight years in the service of that organization.

J. G. Schaub is now assistant chief engineer of the Michigan State Highway Department, with headquarters at Lansing, Mich. He will continue to be in charge of construction and operations.

Claude A. Renshaw, city manager of Miami Beach, Fla., has been appointed acting city engineer, taking over the duties of Morris N. Lipp, who has been given a leave of absence to serve in the Corps of Engineers, U.S. Army.

Gilbert H. Dunstan has been promoted from the position of assistant professor of sanitary engineering at the University of Alabama to that of associate professor.

Chester Canham has been made engineer for one of the first two county health units established in Illinois. His headquarters are at Carbondale.

A. A. Sauer was commissioned a lieutenant commander in the Civil Engineer Corps of the U.S. Naval Reserve in March and is now on leave of absence from the California State Division of Architecture for active duty in the Thirteenth Naval District at Seattle, Wash.

Travis Logan Smith, III, formerly roads and drainage engineer for Lockwood, Andrews, and D. M. Duller at Houston, Tex., has accepted the position of chief engineer for the architectural engineering firm of Niven, Staub, Rather, and Turner. His headquarters are at Big Spring, Tex.

P. S. Monk was recently granted a leave of absence from the South Carolina State Highway Department, for which he was bridge designer, in order to become connected with the J. E. Sirrene Company, of Greenville, S.C., on the construction of an army ammunition depot at Charleston, S.C.

Paul L. Nichols has been called to active duty as a captain in the Corps of Engineers, U.S. Army, and ordered to the Engineer Replacement Training Center at Fort Leonard Wood, Mo. His former position was that of bridge designer for the Nevada State Highway Department at Carson City, Nev.

O. W. Crowley is taking a leave of absence from his post as executive secretary of the Central Branch of the Associated General Contractors of America, with headquarters at Des Moines, Iowa, in order to serve as coordinator on the Alaska Highway Project.

William P. DeJarnette, Jr., major, Corps of Engineers, U.S. Army, has been promoted to the rank of lieutenant colonel. He is stationed in the U.S. Engineer Office at Mobile, Ala.

Theodore S. Johnson, professor of sanitary engineering at North Carolina State College, was recently appointed chief of the North Carolina Office of Price Administration.

Kurt Hueftle, formerly structural draftsman for H. J. Brunnier, of Coco Solo, Canal Zone, has accepted a position as junior engineer for the U.S. Bureau of Reclamation.

Andrew Fischer, Jr., has been elected executive vice-president and director of James Steward and Company, Inc., New York City contracting firm.

Terrence Hedrick, until lately associate engineer in the Department of Design of the Kansas State Highway Commission, is now designer for the Austin Company, of Cleveland, Ohio. Other members to leave the staff of the Kansas State Highway Commission for defense work are Glenn H. Kevan, who has accepted a position in the Shipbuilding Division of the Missouri Bridge and Iron Company at Evansville, Ind., and J. V. Venard, who is with the List and Clark Construction Company on an air-base project at Pueblo, Colo.

William Grant, formerly engineer for Freese and Nichols, of Fort Worth, Tex., has accepted a position with Ford, Bacon and Davis. His headquarters are at Marshall, Tex.

C. D. Wells is now office engineer for Brown and Root, Inc., in Houston, Tex. He was previously with the San Antonio firm of Beavers, Lodal and Wells.

Harry N. Roberts, Lubbock (Tex.) consultant, is serving as chief engineer for the McKenzie Construction Company, of San Antonio, on the construction of the Pantex Ordnance Plant near Amarillo, Tex.

W. F. Castella, former senior office engineer for the City of Corpus Christi, Tex., is now with Williams and Whittle, contractors at Killeen, Tex. Mr. Castella is the contractor's representative to the Army Engineers on the construction of an army camp at that location.

Frank W. Chappell is resident partner for the architect engineer on the Red River Ordnance Depot, with headquarters at Texarkana, Tex.

William C. Gibson will be on leave of absence for the duration of the war from his position as sanitary engineer for the Hillsdale County (Michigan) Health Department in order to accept a call to active duty in the Sanitary Corps of the U.S. Army at Key Field, Miss. He has the rank of first lieutenant.

DECEASED

Albert Morrill Blodgett (M. '04) retired bridge engineer of Kansas City, Mo., died in that city on May 29, 1942. Mr. Blodgett, who was 86, went to Kansas City in 1879 as vice-president of the old Kansas City Bridge Company. He later was associated with E. I. Farnsworth in the bridge contracting business, and finally headed a firm of his own. He constructed the twelve-mile causeway at Galveston, Tex., and bridges and viaducts in many states. During the World War he was in the shipbuilding business at Pascagoula, Miss.

William Warren Orcutt (M. '16) retired engineer of Canoga Park, Calif., died on April 27, 1942, at the age of 73. At the time of his retirement in 1938 Mr. Orcutt had been with the Union Oil Company of California for forty-one years. During this period he had served successively as general superintendent of the San Joaquin Valley Division; manager and chief engineer of the Geological and Land Departments (1899–1922); and vice-president in charge of the Geological and Land Departments. He was a pioneer in the field of petroleum exploration.

Joseph Hyde Pratt (M. '21) engineer consultant of Chapel Hill, N. C., died at his home there on June 2, 1942, at the age of 72. Colonel Pratt was lecturer on mineralogy at the University of North Carolina from 1898 to 1901; state mineralogist from 1897 to 1906; and state geologist from 1905 to 1924. Coincidentally for most of this period (1904 to 1925) he was professor of economic geology at the university. He acted as consultant for the U.S. Geological Survey and other organizations and was the author of numerous articles on engineering and geology. During the first World War he served overseas with the 105th Engineers, having the successive ranks of major, lieutenant colonel, and colonel. He was awarded a Distinguished Service Medal.

Emmett Filmore Collins (M. '13) retired engineer of Crown Point, Ind., died on May 8, 1942, at the age of 69. Mr. Collins was location and construction engineer for various railways from 1894 to 1910, and assistant engineer for the St. Louis–Santa Fe Railway Company from 1911 to 1916. For the next three years he served as valuation engineer for the St. Louis–Santa Fe Railway, and from 1919 until his retirement in 1937 maintained a consulting practice.

John Lyle Harrington (M. '03) consulting engineer of Kansas City, Mo., died there on May 20, 1942, at the age of 73. In private practice in Kansas City since 1907 (at the time of his death he was senior partner in the firm, Harrington and Cortelyou), he designed many bridges in the United States, Canada, Russia, Manchuria, China, and Japan. During this period he was much interested in developing the vertical lift bridge and held many patents on it and the bascule bridge. He had served as vice-president and president of the American Society of Mechanical Engineers.

Merton Roscoe Keefe (M. '20) chief engineer for the Indiana State Highway Commission, Indianapolis, Ind., died suddenly at Evansville, Ind., on May 12, 1942. He was 60. As construction manager for Ulen and Company, Mr. Keefe had done extensive municipal engineering work in the United States and various European countries. Notable projects on which he was engaged included a water-supply system for Athens, Greece; a large drainage and reclamation project in eastern Macedonia; and a 450-mile railroad north from the Persian Gulf (now the chief Allied supply line to Russia). In 1933 he became connected with the Indiana State Highway Department.

Edwin Kirtland Morse (M. '00) retired consultant of Pittsburgh, Pa., died in that city on May 28, 1942. Mr. Morse, who was 85, was for some years chairman of the Pittsburgh Flood Commission. Many of the surveys and findings of his committee over a period of years were followed by the U.S. Corps of Engineers, which finally undertook the construction of flood-impounding dams to protect the Pittsburgh area from floods. During his early career he worked in his brother's bridge works at Youngstown, Ohio, and represented the company in Chicago until 1887. He then went to Sydney, Australia, as engineer on the construction of the Hawkesbury Bridge at Dangar Island. From 1892 until his retirement he maintained a consulting practice in Pittsburgh. During this period he designed and constructed a number of bridges and substructures across the Monongahela and Ohio rivers. He also served as consultant to the Jones and Laughlin Steel Corporation for twelve years, and to the City of Pittsburgh for four years. Long active in the affairs of the Society, Mr. Morse was Director from 1931 to 1933.

EDWIN K. MORSE

Ralph Earle Rohn (M. '22) for the past two years specification engineer for the H. K. Ferguson Company, of Cleveland, Ohio, died at Canton, Ohio, on April 29, 1942. He was 54. Before going to the Ferguson Company Mr. Rohn for some years maintained a consulting practice in Canton. He had also been chief engineer of the Canton Bridge Company.

James Gilbert White (M. '04) chairman of J. G. White and Company, Inc., of New York, N.Y., died at his home in Greenwich, Conn., on June 2, 1942. Mr. White, who was 80, retired some years ago as active head of the organization. In his early career he taught at the University of Nebraska, leaving in 1887 to found the Western Engineering Company, which did pioneer work in the construction of electric railways. In 1890 the company was sold, and he established in New York the firm of J. G. White and Company, the first of several such. His organizations later engaged in extensive engineering operations here and abroad. Mr. White designed and constructed the Buffalo-Niagara Falls Electric Railroad, one of the first high-speed electric roads, and his work in this field had much to do with the development of inter-city electrical transportation.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From May 10 to June 9, 1942, Inclusive

ADDITIONS TO MEMBERSHIP

Averill, Walter Albert (Affiliate '42), Vice-Pres. and Mgr., Pacific Builder and Engr., Inc., 3102 Arcade Bldg., Seattle (Res., Evergreen Point, Bellevue), Wash.

Avery, Edward Frederick (Jun. '42), Superv. Engr., RFC-DPC, Washington, D.C.

Bauernschmidt, John George (Assoc. M. '42), Dist. Mgr., H. H. Robertson Co., 1635 Baltimore Trust Bldg., Baltimore, Md.

Berrigan, Thomas Augustine (M. '42), San. Engr., Metropolitan Dist. Comm., 20 Somerset St., Boston (Res., 108 High Rock Lane, Westwood), Mass.

Bissett, James Robert (Assoc. M. '42), Associate Engr., Area Engrs.' Office, U.S. Engrs., Re placement Center, Kelly Field (Res., 218 Kirk Pl., San Antonio), Tex.

Blickensderfer, Justin Shepard (Jun. '41), 2d Lt., 110th Observation Squadron, U.S. Army, Army Air Base, Salinas, Calif.

Borders, Coy W. (Assoc. M. '42), Acting City Engr., City Hall, Waco, Tex.

Boyd, James Thornton (Assoc. M. '42), Asst. Engr. (Civ.), U.S. Engrs., Federal Bldg. (Res., 1055 Virginia St.), Mobile, Ala.

Brock, Benjamin Franklin, Jr. (Assoc. M. '42), Chf. Engr., Chandler Brothers, Inc., Box 961, Columbus, Miss. (Res., 404 North Hickory St., Tuscumbia, Ala.)

Brown, Robert Ely (Assoc. M. '42), Structural Engr., A. Bentley & Sons Co., 201 Belmont Ave. (Res., 521 West Bancroft St.), Toledo, Ohio.

Burbank, Oscar Frank (Assoc. M. '42), Supt., Hope Cemetery Dept., 119 Webster St., Worcester, Mass.

Burklin, William Boyd (Jun. '41), Junior Civl Engr., Humble Oil & Refining Co., Box 169, Center, Tex.

Causby, Allen (Assoc. M. '42), Sales Engr., The Armco International Corp., Middletown, Ohio.

Chan, Louis (Jun. '42), Asst. Engr. (Hydr.), U.S. Engr. Office, 751 South Figueroa St. (Res., 427 South Hope St.), Los Angeles, Calif.

Christian, William Earl (Assoc. M. '42), Constr. Engr., Standard Bitulithic Co., 50 Church St., New York, N.Y. (Res., Lakeview Blvd., R. D. 19, New Brunswick, N.J.)

Clagett, Hugh Caldwell (Jun. '41), Structural Engr., Bureau of Yards and Docks, U.S.N., Washington, D.C. (Res., Upper Marlboro, Md.).

Crosby, Lloyd Russell (M. '42), Gen. Mgr., Consolidated Timber Co., 812 Am. Bank Bldg., Portland, Ore.

Cropsey, Willis Hawley (Assoc. M. '42), Chf. Engr. and Supt., Sewage Treatment Plant, City of St. Paul, Box 156, South St. Paul, Minn.

De Lawder, Clyde Ernest (Assoc. M. '42), Chf. Engr., Irrig. & Mech., Cia Agricula de Guatemala, Tiquisate, Guatemala.

Docter, Eugene Wilson (Jun. '41), Mount Sewickley Camp, Route 2, Sewickley, Pa.

Endicott, Clinton LeRoy (Jun. '41), Junior Agri. Engr., SCS, U.S. Dept of Agriculture, Box 123, Worland, Wyo.

Erickson, Iver (Assoc. M. '42), Design Engr., Standard Oil Co. of Indiana, Sugar Creek (Res., 3458 East 62d St., Kansas City), Mo.

Farley, Joseph Raymond (Jun. '41), 29 Elizabeth St., Baldwinsville, N.Y.

Flinn, Everett Barnes (M. '42), Area Engr., WPA, 410 Old Custom House (Res., 605 Clara Ave.), St. Louis, Mo.

Freeman, Philip Drew (M. '42), Chf. Designer, R. Stuart Royer, 117 West Tazewell St., Norfolk, Va.

Fubini-Ghiron, Gino (Jun. '42), Designer, Am. Gas & Elec. Service Corp., 30 Church St. (Res., 88 Central Park West), New York, N.Y.

Fuller, Harry Lawrence (Assoc. M. '42), Civ., Engr., Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo.

Gaffney, Charles Malcolm (Jun. '42), Associate Engr., Area Engrs. Office, Camp Bowie, Brownwood (Res., 1145 West Agarita Ave., San Antonio), Tex.

Garver, Mark Gillespie (Assoc. M. '42), Res. Engr., J. E. Greiner Co., 1201 St. Paul St., Baltimore, Md.

Geissinger, David Stichter (Jun. '41), Field Engr., Dravo Corp., 315 Ballengee St., Hinton, W.Va.

Giese, Louis Paul (Jun. '42), Office Engr., G. M. Barton Survey Co., 618 Madison Ave. (Res., 4554 Douglas Rd.), Toledo, Ohio.

Grant, Nye (Assoc. M.'42), Asst. Hydr. Engr., U.S. Geological Survey, 404 Eng. Experiment Station, Ohio State Univ. (Res., 69 Brighton Rd.), Columbus, Ohio.

Hacken, Nephi Rudolph (Jun. '41), Junior Engr., U.S. Engr. Dept., Post Office Bldg. (Res., 1820 H St.), Sacramento, Calif.

Harris, Galen Stanley (Jun. '41), Care, Ship Supt. Office, Navy Yard, Pearl Harbor, Hawaii.

Hegarty, Thomas Edward (Assoc. M. '42), City Engr., City Hall (Res., 42 Minnesota Ave.), Somerville, Mass.

Hill, Bancroft (M. '42), Pres., Baltimore Transit Co., Equitable Bldg., Baltimore, Md.

Hilton, William Lawrence (Jun. '41), Ensign, CEC, U.S.N., David W. Taylor Model Basin, Carderock, Md.

Hockersmith, Forrest Davitte (Assoc. M. '42), Asst. Director, Defense Coordinating Section, WPA, 1734 New York Ave., N.W., Washington, D.C. (Res., 3108 Tenth Rd., North, Arlington, Va.)

Hofeldt, Henry, Jr. (Assoc. M. '42), Chf. Draftsman, Weiskopf & Pickworth, 45 West 45th St., New York (Res., 141–21 Two hundred and twenty-eighth St., Rosedale), N.Y.

Hogue, Walter Robert (Jun. '41), Care, Giffels & Vallet, Inc., 1000 Marquette Bldg., Detroit, Mich.

Holman, Jacob Charles (M. '42), Pres., Hol man Constr. Co., Inc., 250 West 57th St., New York, N. Y.

Horton, Harold Burris (Jun. '42), Structural Engr., Wyatt C. Hedrick, Inc., U.S. Naval Air Base, Care, Res. Engr. in Chf., Contract NOy 4258, New Orleans, La.

Howland, George William, Jr. (Jun. '41), Care, Company A, 2d Battalion, Engr. Replacement Training Center, Fort Belvoir, Va.

Illk, Frank Keith (Jun. '41), 426 West Washington St., Dunkirk, Ind.

Imperato, Nicholas Flloyd (Jun. '42), Designer, Ebasco Services, Inc., 63 Court House Pl., Jersey City, N.J.

Joines, Glenn Vivian (Assoc. M. '42), Senior Engr., State Highway Comm., Roads Materials Laboratory (Res., 925 Osage St.), Manhattan, Kans.

Kaiser, Frederick Maxwell (Assoc. M. '42), Estimator, Purchasing Agt., North Eastern Constr. Co., 101 Park Ave., New York (Res., 1078 East 32d St., Brooklyn), N.Y.

Keller, Allen William (Assoc. M. '52), Cons. Engr., 3415 Tibbett Ave., New York, N.Y.

Koch, Wilhelm Emil (Assoc. M. '42), Chf. Engr., Geo. J. Glover Co., Inc., Whitney Bldg. (Res., 2627 Coliseum St.), New Orleans, La.

Krocker, Robert Adolph (Jun. '42), Junior Engr. (Structural), U.S. Engr. Dept., Box 1738 (Res., 2526 Buena Vista), San Antonio, Tex.

Kroup, Benjamin Adam (Assoc. M. '42), Field Supt., W. E. Callahan Const. Co., 2723 Trice Ave., Waco, Tex.

Levine, Benjamin (Assoc. M. '42), Structural Designer, Frederic R. Harris, Inc., 27 William St. (Res., 1475 Grand Concourse, Apt. F 52), New York, N.Y.

Lincoln, Frank Louis (M. '42), Engr., Fay, Spofford & Thorndike, 11 Beacon St., Boston (Res., 23 Linden St., Arlington Heights), Mass.

Lloyd, Clyde Leonard, Jr. (Jun. '42), Engr., Sheffield Steel Corp. of Texas (Res., 4829 McKinney Ave.), Houston, Tex.

McBride, Graham Loader (Jun. '41), With Air Corps, U.S. Army, A.F.R.T.C. Squadron E, Ellington Field, Tex. (Res., 3806 North 6th St., Phoenix, Ariz.)

Maggi, Elmer James (Jun. '42), 2d Lt., Corps of Engrs., U.S. Army, 820th Engr. Battalion (Aviation), Pendleton, Ore.

Marec, Giles Louis (Assoc. M. '42), Structural Engr., Semet Solvay Eng. Corp., 40 Rector St. (Res., 640 West 153d St.), New York, N.Y.

Melchor, Alejandro (M. '42), Prof., Eng., Philippine Military Academy, The Engr. Board, Fort Belvoir, Va.

Morales, Juan Alberto (Assoc. M. '42), Civ. Engr., Morales y Cia, Calle 33 Este 38, Panama, Panama.

Moreland, John Wylie (M. '42), Lt. Col., Corps of Engrs., U.S. Army; Dist. Engr., U.S. Engr. Office, 1222 New Post Office Bldg., St. Paul, Minn.

Mumford, Frank Morris (Assoc. M. '42), Asst. Engr., Black & Veatch, 4706 Broadway, Kansas City, Mo. (Res., 515 Filhiol Ave., Monroe, La.)

Nelson, Herman Lemar (Assoc. M. '42), Res. Engr., State Highway Dept., Box 537, Huntsville, Ala.

Nickey, Henry Eugene (Assoc. M. '42), Civ. Engr., U.S. Engrs., Arlington (Res., D-1, Jackson, Presidential Gardens, Alexandria), Va.

Nixon, Marion Blair (Assoc. M. '42), Asst. Engr. of Sewers, Constr. Dept., City of Atlanta, 302 City Hall (Res., 1357 Berwick Ave., N.E.), Atlanta, Ga.

Ogilvie, Thomas Whyte (Assoc. M. '42), County Engr., Lassen County, Court House, Susanville, Calif.

Otterson, George Leonard (Assoc. M. '42), Associate Engr. (Civ.), Special Eng. Div., The Panama Canal, Diablo Heights (Res., Margarita), Canal Zone.

Parsons, James Dana (Assoc. M. '42), Soil Mechanics Engr., Moran, Proctor, Freeman & Mueser, 420 Lexington Ave., New York (Res., Van Wyck Gardens, Croton-on-Hudson), N.Y.

Perkins, Gerald Stephen (Jun. '42), Research Engr., Mass. Inst. Tech., Cambridge, Mass.

Piper, Harry William (Jun. '42), Chf. Eng. Draftsman (Structural), Bureau of Yards and Docks, Public Works Drafting Room, Navy Yard (Res., 1012 Douglas St., N.E.), Washington, D.C.

Raciti, Frank Frontinus (Jun. '41), 64 Baldwin St., New Brunswick, N.J.

Rea, John Edward, Jr. (Jun. '41), Junior Engr., U.S. Bureau of Reclamation, 403 Capitol Bldg., Oklahoma City, Okla.

Redlinger, Jacob Francis (Jun. '41), Junior Engr., U.S. Engrs., Clock Tower Bldg., Rock Island, Ill. (Res., Y.M.C.A., Davenport, Iowa.)

Rowley, Philo Mells (Assoc. M. '42), Associate Civ. Engr., U.S. Engrs., 505 Federal Bldg., 6th and Broadway (Res., 944 Ash St.), Louisville, Ky.

Schofield, Calvin Onderdonk (Assoc. M. '42), Chf., Eng. Section, U.S. Engrs., Keystone Ordnance Works, Box 124, Meadville, Pa.

Shears, William Henry (Jun. '42), 404 East 6th, Hutchinson, Kans.

Sheridan, Emmett Hugh (Assoc. M. '42), Lt., U.S. Coast and Geodetic Survey, Washington, D.C.

Smith, Patrick Benton (Assoc. M. '42), Constr. Engr., Schulz & Norton, 870 Shrine Bldg. (Res., 1800 Poplar, Apt. 7), Memphis, Tenn.

Stancer, William Arthur (Assoc. M. '42), Constr. Engr. (Civ.), Guy F. Atkinson Co., Enumclaw (Res., 4617 South Fawcett, Tacoma), Wash.

Stock, Leo Francis, Jr. (M. '42), Civ. Engr., Wilberding Co., Inc., 1822 Eye St., N.W. (Res., 3900 Thirteenth St., N.E.), Washington, D.C.

Tamminga, Samuel William (Jun. '41), With Giffels & Vallet, Inc., 1000 Marquette Bldg. (Res., 4117 Beaconsfield), Detroit, Mich.

Tebow, Henry Jule (Assoc. M. '42), Capt., Corps of Engrs., U.S. Army, Box 4970, Jacksonville, Fla.

Turner, William Wesley (Assoc. M. '42), Div. Engr., Hart, Freeland & Roberts, Blue Grass Ordnance Depot, Richmond, Ky.

Ullman, Samuel Lehman (Assoc. M. '42), Engr. Designer, Kistner, Curtis & Wright, Goleta (Res., 238 Stanley Drive, Santa Barbara), Calif.

Vogtle, John Carl (Jun. '41), Structural Engr., Budd Mfg. Co., 25th and Hunting Park Ave. (Res., 4730 D St.), Philadelphia, Pa.

Wallace, Felix Anthony (Assoc. M. '42), Acting Asst. Engr., B.M.T. Div., New York City Transit System, 849 Nostrand Ave. (Res., 1430 East 56th St.), Brooklyn, N.Y.

Weinroth, Max (Assoc. M. '42), Engr. (Civ.), Constr. Div., Office, Chf. of Engrs., 21st St. and Virginia Ave., N.W., Washington, D.C.

Wingard, James Hoyt (Assoc. M. '42), Senior Engr. and Supt., Constr., Corps of Engrs., U.S. Army, Care, Utilities, Fort Knox, Ky.

Winter, Francis Ellis (M. '42), Highway Engr., Federal Works Agency, Public Roads Administration, Box 869 (Res., 1303 Division St.), Vicksburg, Miss.

Woodall, Max Theodore (Assoc. M. '42), Care, United Engrs. & Constrs., Inc., Box 214, Monsanto, Ill.

Young, William Nelson (M. '42), Asst. Engr., B. & O.R.R., Baltimore & Charles Sts., Baltimore, Md. (Res., 207 Hart Blvd., Staten Island, N.Y.)

Membership Transfers

Arnold, Hugh Montgomery (Jun. '37; Assoc. M. '42), Capt., Corps of Engrs., U.S. Army, Area Engr., U.S. Engr. Area Office, Army Post Office 869, Care, Postmaster, New York, N.Y.

Butkiewicz, Joseph Wallace (Jun. '35; Assoc. M. '42), 1st Lt., Corps of Engrs., U.S. Army, Company G, 21st Engrs., Langley Field, Va.

Censullo, Xavier Francis (Jun. '30; Assoc. M. '42), Lt. (jg), CEC, V-(S), U.S.N.R., Marine Barracks, New River, N.C.

Chape, Bruno (Jun. '31; Assoc. M. '41), Lt., Corps of Engrs., U.S. Army, Corps Area Engr. Office, Governors Island, N.Y.

Clifton, John Rodgers (Jun. '30; Assoc. M. '42), Capt., Coast Artillery Corps, U.S. Army

Battery K, 64th Coast Artillery (Anti-Aircraft), Army Post Office 953, Care Postmaster, San Francisco, Calif.

Crawford, Glenn Arthur (Jun. '33; Assoc. M. '42), Senior Eng. Aide, City of Burbank, 272 East Olive Ave. (Res., 234 South Sparks St.), Burbank, Calif.

Dalphond, Arthur (Jun. '34; Assoc. M. '42), Production Engr., Federal Shipbuilding & Dry Dock Co., Lincoln Highway Kearny (Res., 110 North 17th St., East Orange), N.J.

Elsener, Lawrence Alois (Assoc. M. '27; M. '42), Dist. Mgr., Chicago Bridge & Iron Co., 416 Rialto Bldg., San Francisco, Calif.

Emigh, William Chester (Assoc. M. '18; M. '42), City Engr., City Hall, Coatesville, Pa.

Goodpasture, Robert Abraham (Jun. '39; Assoc. M. '42), Capt., 157th Infantry, U.S. Army, Army Post Office 45, Care, Postmaster, New York, N.Y.

Griffin, Robert Hardy (Jun. '32; Assoc. M. '42), Hydroelectric Engr., U.S. Forest Service, Phelan Bldg., San Francisco (Res., 5909 Contra Costa Rd., Oakland), Calif.

Hobart, Thomas Fitzhugh (Jun. '28; Assoc. M. '36; M. '42), Asst. Div. Engr., State Highway Dept., 930 Martin Bldg., Birmingham, Ala.

Holzer, Ernest (Assoc. M. '33; M. '42), Civ. Engr., 196 Pinehurst Ave., New York, N.Y.

Hummel, Russell Sutcliffe (Assoc. M. '25; M. '42), State Administrator, WPA, 11 South 12th St. (Res., 2800 Hawthorne Ave.), Richmond, Va.

Keller, Frank, Jr. (Jun. '35; Assoc. M. '42), Asst. Agri. Engr., Range Development Service, Gen. Land Office, Box 166, Santa Fe, N.Mex.

Koffsky, Samuel (Jun. '28; Assoc. M. '32; M. '42), Chf. Engr., Simmons Machine Tool Corp., North Broadway (Res., 845 Park Ave.), Albany, N.Y.

Leonard, Raymond Wesley (Jun. '38; Assoc. M. '42), Asst. Hydr. Engr., Water Resources Branch, U.S. Geological Survey, 220 Post Office Bldg., Asheville, N.C.

Munz, Oliver Wesley (Jun. '30; Assoc. M. '42), Lt., CEC, U.S.N.R., Asst. Officer in Chf., Constr., Air Operational Training Bases, Naval Air Station, Jacksonville, Fla.

Ortolani, Walter Albert (Jun. '26; Assoc. M. '34; M. '42), Senior Res. Engr., State Highway Dept., Box 494, Gilmer, Tex.

Poole, Blucher Adams (Assoc. M. '38; M. '42), Chf. Engr., State Board of Health, 1098 West Michigan St. (Res., 4735 Sunset Blvd.), Indianapolis, Ind.

Pritchard, Elmer Marion (Jun. '36; Assoc. M. '42), Dist. Laboratory Engr., State Highway Dept. (Res., 1712 Ave. C), Brownwood, Tex.

Quilty, Thomas Patrick (Jun. '36; Assoc. M. '42), Lt. (jg), U.S.N.R., 884 Riverside Drive, New York, N.Y.

Rayner, William Horace (Assoc. M. '24; M. '42), Associate Prof., Civ. Eng., Univ. of Illinois (Res., 715 West Iowa St.), Urbana, Ill.

Reynolds, Embree Ensign (Jun. '38; Assoc. M. '42), Capt., Ordnance Dept., U.S. Army, Office, Chf. of Ordnance, Washington, D.C. (Res., Pierce Bldg., Apt. D-11, Presidential Gardens, Alexandria, Va.)

Robey, Walter Earl (Assoc. M. '35; M. '42), Asst. Engr., Bridge Dept., A.T. & S.F. Ry., 80 East Jackson Blvd. (Res., 8007 Drexel Ave.), Chicago, Ill.

Saylor, William Henry (Jun. '35; Assoc. M. '41), Associate Engr., U.S. Engr. Dept., 751 South Figueroa St. (Res., 802½ East Kensington Rd.), Los Angeles, Calif.

Sachse, Alfred John (Jun. '33; Assoc. M. '42), Res. Engr., State Bureau of Highways (Res., 764 Government Way), Coeur d'Alene, Idaho.

Sack, Adam Francis (Jun. '36; Assoc. M. '42), Utilities Draftsman, Whitman, Requardt & Smith, Edgewood Arsenal (Res., 4806 Belair Rd., Baltimore), Md.

TOTAL MEMBERSHIP AS OF JUNE 9, 1942

Members	5,784
Associate Members	6,951
Corporate Members	12,735
Honorary Members	35
Juniors	4,966
Affiliates	70
Fellows	1
Total	17,807

Serber, Gilbert Mortimer (Assoc. M. '30; M. '42), Pres., Stock Constr. Corp., Grand Central Terminal, New York, N.Y.

Simon, William John (Jun. '35; Assoc. M. '42), Lt. (jg), CEC, U.S.N.R., Headquarters 8th Naval Dist., Federal Bldg., New Orleans, La.

Snyder, Franklin Farison (Jun. '34; Assoc. M. '42), Associate Hydrologic Engr., U.S. Weather Bureau, Weather Bureau Office, Washington, D.C.

Stites, Howard Ingham (Assoc. M. '33; M. '42), City Mgr., City Hall (Res., 1066 East Angeleno Ave.), Burbank, Calif.

Thomas, Roderic Bruce (Jun. '24; Assoc. M. '27; M. '42), Town Engr., 4700 Drexel Drive, Highland Park, Tex.

Waterbury, Lawrence Stuart (Assoc. M. '36; M. '42), Associate Engr., Parsons, Klapp, Brinckerhoff & Douglas, 142 Maiden Lane, New York, N.Y.

Watford, Troy Ellis (Assoc. M. '37; M. '42), City Engr. and Supt. of Water Works, City Hall, Gadsden, Ala.

Wilson, Guthlac (Assoc. M. '35; M. '42), Director, Constructional Design, Ministry of Works and Buildings, Lambeth Bridge House, Albert Embankment, London, S.E. 1 (Res., 562 Kensington Close, Wrights Lane, London, W. 8), England.

REINSTATEMENTS

Doebler, Horatio Ward, Assoc. M., reinstated June 4, 1942.

Grimes, James Edward, Assoc. M., reinstated May 21, 1942.

McClintock, Hallett Edward, M., reinstated June 2, 1942.

Moss, Robert Faulkner, M., reinstated May 25, 1942.

Nabow, David, M., reinstated June 2, 1942.

Poulter, Alfred Fearey, Assoc. M., reinstated May 18, 1942.

Savidge, Samuel Leigh, Assoc. M., reinstated June 3, 1942.

RESIGNATIONS

Hutchins, Melvin Ralph, Jun., resigned Apr. 30, 1942.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

JULY 1, 1942

NUMBER 7

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

Ballinger, Web Wilkins, Grand Junction, Colo. (Age 39) (Claims RCA 2.8 RCM 10.5) Jan. 1941 to date Sales Engr., R. Hardesty Mfg. Co.; previously Dist. Engr. and Dist. Mgr., WPA, Grand Junction, Colo.

Barnes, Bertram Soules (Assoc. M.), Iowa City, Iowa. (Age 45) (Claims RCA 6.5 RCM 7.9) Aug. 1936 to date with U.S. Weather Bureau as Hydrologic Supervisor, and (since Jan. 1942) Regional Engr., Region 3.

Battershill, Charles Arthur, Glen Ellyn, Ill. (Age 47) (Claims RCA 8.4 RCM 10.0) Nov. 1934–Jan. 1937 and March 1942 to date San. Engr., Warren & Van Praag, Inc., Decatur, Ill.; in the interim Cons. Engr. in private practice, and Asst. Constr. Engr. on sewage-treatment plant construction.

Beckett, Humphrey, Lanham, Md. (Age 64) (Claims RCA 9.2 RCM 27.1) Aug. 1901 to date with Dist. of Columbia Govt., as Chainman, Rodman, Chf., Valve Sec., Asst. Engr., Associate Engr., Asst. Supt. and Senior Engr., and (since June 1941) Supt. and Chf. Engr.

Brockway, George Samuel (Assoc. M.), West Palm Beach, Fla. (Age 45) (Claims RCA 3.5 RCM 14.4) Aug. 1938 to date in private practice, being Cons. Engr. for Town of Palm Beach; City Engr., West Palm Beach; Manager and Engr., Port of Palm Beach; Engr., Jupiter Inlet Dist.; previously member of firm, Fugate and Brockway, Engrs.

Bulfinch, Francis Vaughan, Boston, Mass. (Age 63) (Claims RCA 5.0 RCM 33.5) 1924 to date member of firm, Coolidge, Shepley, Bulfinch & Abbott, Archts.

Clark, Jay Hobart Francis (Assoc. M.), Madison, Conn. (Age 53) (Claims RCA 8.9 RCM 18.1) Jan. 1926 to date Asst. Engr., Engr.'s office, The Connecticut Co.

Dolan, Leonard Zadok, Weldon Spring, Mo. (Age 39) (Claims RCA 5.0 RCM 8.1) Nov. 1940 to date with Fraser-Brace Eng. Co., Inc., as Asst. Works Mgr.; previously with U.S. Navy Dept., and PWA.

Ebling, Everett Ernest (Assoc. M.), Chicago, Ill. (Age 41) (Claims RCA 8.0 RCM 7.8) June 1928 to date with Bldg. Specialties Eng. Dept., Bethlehem Steel Co., since Sept. 1934 being Head of Dept.

Gardner, John Miles, New York City. (Age 57) (Claims RCA 5.1 RCM 19.5) Dec. 1917 to date with The Austin Co., as Designing Engr., Dist. Estimator, and (since Jan. 1929) Chf. Estimator.

Grimm, James Walter, Chicago, Ill. (Age 38) (Claims RCA 4.2 RCM 10.8) March 1934 to date with City of Chicago, as Res. Engr., San. Dist., and (since Oct. 1938) Senior Res. Engr., Dept. of Subways and Superhighways.

Grupe, Edgar Young (Assoc. M.), Omaha, Nebr. (Age 48) (Claims RCA 0.4 RCM 27.3) Feb. 1942 to date Chf. Inspector (Utility), Nebraska Ordnance Plant, Giffels & Vallet, Archt. Engrs. of Detroit, Mich.; previously Vice-Pres., acting as Gen. Supt., Allied Bridge & Constr. Co., and Empire Constr. Co., Omaha, Gen. Contrs.

Harris, Heber, San Angelo, Tex. (Age 43) (Claims RCA 3.2 RCM 11.0) April 1941 to date Structural Designer for various employers, at present with Ford, Bacon & Davis, Engrs.; previously Senior Engr., Rollins & Forrest, Engrs.; Koch & Fowler, Engrs.; Cons. Engr. on structural designing and detailing.

Hefling, Arthur William (Assoc. M.), Hutchinson, Kans. (Age 43) (Claims RCA 2.5 RCM 14.7) Feb. 1934 to March 1935 and Jan. 1936 to date Gen. Mgr. and Chf. Engr., The Hefling & Hughes Eng. Co.; since May 1942 Lt. Comdr., CEC, U.S.N.R., on active duty.

Huey, Stanton Ennes (Assoc. M.), Monroe, La. (Age 43) (Claims RCA 4.0 RCM 14.0) 1941 to date member of firm, Huey & Cage, Monroe, La., Freeman, Christiansen, Huey & Cage, Shreveport, La.; previously Member, Board of State Engineers, Louisiana.

Kemp, Harold Augustus, Arlington, Va. (Age 48) (Claims RCA 7.1 RCM 18.1) April 1931 to Nov. 1934 Senior Engr., April 1937 to Nov. 1938 Prin. Engr., and Oct. 1940 to date Head Engr., Office, Chf. of Engrs., Corps of Engrs., U.S. Army; in the interim Prin. Engr., Dept. of San Eng., District of Columbia.

Kline, Carroll Nathan Raver (Assoc. M.), Niagara Falls, N.Y. (Age 41) (Claims RCA 2.1 RCM 14.4) March 1942 to date Asst. Chf. Engr. (Chf. Design Engr.), J. G. White Eng. Corporation, Lake Ontario Ordnance Works, Lewiston, N. Y.; previously with Pennsylvania WPA as Asst. Dist. Director, and Asst. to Director of Div. of Operations.

Maguire, Michael (Assoc. M.), Dublin, Ireland. (Age 44) (Claims RCA 4.8 RCM 13.6) March 1939 to date Chf. Engr., Turf Development Board, Dublin, Ireland; previously Engr., Walsh Constr. Co., New York City.

Munson, Wendell Curtis, Laramie, Wyo. (Age 37) (Claims RCA 5.9 RCM 5.7) Sept. 1938 to Sept. 1941 Asst. Hydr. Engr., Sept. 1941 to April 1942 Associate Water Planning Analyst, and April 1942 to date Water Planning Analyst, Bureau of Agricultural Economics, Water Utilization Planning Service; previously with Summitville (Colo.) Mines, Inc.

Odom, Leo Myers (Assoc. M.), Baton Rouge, La. (Age 36) (Claims RCA 5.6 RCM 7.8) Feb. 1941 to date with Louisiana Dept. of Public Works, as Office Engr., and (at present) Chf. Engr. of State Dept.; previously with Corps of Engrs., U.S. Army as Party Chf., Asst. Engr., Asst. to Res. Engr., Res. Engr., Engr., etc.

Plank, Ewart Gladstone (Assoc. M.), Alexandria, Va. (Age 44) (Claims RCA 6.3 RCM 10.6) June 1920 to date with U.S. Army, as 2d and 1st Lieut. serving in various capacities, Jan. 1941–May 1942 Chf. of Air Corps Projects Sec., Operations Branch Constr. Div., Office of Chf. of Engrs., Washington, D.C., and (at present) detailed to Gen. Staff Corps on troop duty.

Queneau, Roland Blaisdell (Assoc. M.), Cincinnati, Ohio. (Age 40) (Claims RCA 7.8 RCM 7.2) April 1924 to date Field Engr., The Pitometer Co., Inc., New York City.

Robbers, Joseph Clifford, St. Paul, Minn. (Age 49) (Claims RCM 25.2) March 1942 to date with Corps of Engrs., since May 1942 as Major; April 1919 to March 1942 with Minnesota Highway Dept.

Schmitz, Erwin Anthony, St. Louis, Mo. (Age 52) (Claims RCA 16.3 RCM 6.1) Nov. 1916 to date with City of St. Louis, Mo., as Asst. Civ. Engr., Civ. Engr., Senior Civ. Engr., and (since May 1941) Asst. Chf. Engr., Bridges and Bldgs. Sec.

Stevens, Elmer Bradford (Assoc. M.), Balboa Heights, Canal Zone. (Age 41) (Claims RCA 7.0 RCM 5.0) May 1936 to date with Office Eng. Div., The Panama Canal, as Structural Designer, Asst. Engr. Associate Engr., and Structural Engr.

Sullens, James Richard, Jr., Baltimore, Md. (Age 38) (Claims RCA 3.6 RCM 10.3) March 1942 to date Designing Engr. with Robert T. Regester, Cons. Engr.; March 1942 Asst. Civ. Engr., Albright & Friel, Inc., Aberdeen Proving Grounds, Md.; previously Designer, Whitman, Requardt & Smith, Edgewood Arsenal, Md.; Asst. Civ. Engr., Bureau of Sewers, Baltimore, Md.

Todd, Clarence Lionel (Assoc. M.), Pittsburgh, Pa. (Age 60) (Claims RCA 3.9 RCM 28.7) May 1913 to date with Pittsburgh-Des Moines Steel Co., in various capacities, since Nov. 1929 Mgr. and Chf. Engr., Incinerator Div.

Turney, John Garrett (Assoc. M.), Houston Tex. (Age 35) (Claims RCA 4.2 RCM 9.9) May 1939 to date with City of Houston, Tex., as First Asst. City Engr., and (since Jan. 1941) Director of Public Works; previously Chf. Engr., R. R. Comm. of Tex.; in private practice, Wharton, Tex.

Van Camp, Paul Milton (Assoc. M.), Southern Pines, N.C. (Age 46) (Claims RCA 1.0 RCM 15.9) Jan. 1933 to date Cons. Engr., specializing in municipal water and sewerage systems.

Wertz, Claude Franklin (Assoc. M.), Miami, Fla. (Age 44) (Claims RCA 12.2 RCM 9.3) July 1941 to date Res. Engr., Dept. of Water and Sewers; previously Prin. Asst. Engr., Havens & Emerson, Cons. San. Engrs., New York City.

Will, Walter George (Assoc. M.), Cleveland, Ohio. (Age 57) (Claims RCA 10.2 RCM 18.6) July 1939 to date Commander, U.S.C.G.; previously with U.S. Lighthouse Service as Asst. Supt. and Supt. of Lighthouses (Prin. Lighthouse Engr.).

Wise, Nelson Eldon, Balboa, Canal Zone. (Age 36) (Claims RCA 4.2 RCM 6.0) Oct. 1939 to date with The Panama Canal, Mun. Eng. Div., as Jun. Engr., Asst. Engr., and (since July 1941) Associate Engr.; previously Inspector on construction of de-watering bulkheads for South Chicago Water-Filtration Plant; with Indiana Highway Comm.

immermann, John Sylvester Michael, Highland Park, Mich. (Age 40) (Claims RCA 3.0 RCM 11.8) May 1940 to date with Lathrop Hoge Constr. Co., Cincinnati, Ohio, as Detroit Representative, and (since Jan. 1942) member of firm; previously Constr. Engr. for Univ. of Michigan; with PWA.

APPLYING FOR ASSOCIATE MEMBER

Armiger, Oliver Leroy, Baltimore, Md. (Age 44) (Claims RCA 6.0 RCM 5.0) 1940 to date Pres., Armiger Constr. Corporation; previously Chf. Engr., Baltimore Contrs.; Res. Engr., Prack and Prack, Pittsburgh, Pa.

Barnes, Jack Yale, Clear Lake, Iowa. (Age 33) (Claims RCA 3.3 RCM 4.2) March 1937 to date with Portland Cement Association as Office Engr. and (since April 1938) Field Engr.

Blue, Walter Anthony, Clayton, Mo. (Age 42) (Claims RCA 16.2) Feb. 1941 to date member, construction firm, Manser & Blue Co., Brentwood, Mo.; previously Const. Engr. and Supt., Samuel Kraus Co., St. Louis, Mo.

Bovay, Harry Elmo, Jr. (Junior), Baytown, Tex. (Age 27) (Claims RCA 3.0 RCM 0.7) June 1937 to date with Humble Oil & Refining Co., as Jun. Metal Inspector, Jun. Mech. Engr., Asst. Project Engr., and (since Nov. 1941) Mech. Engr.

Casson, Loyd Thomas, St. Louis, Mo. (Age 37) (Claims RCA 2.3 RCM 3.9) March 1941 to date with Terminal Railroad Association of St. Louis, Mo., as Res. Engr., and (since Sept. 1941) Bridge Engr.; previously with U.S. Engr. Dept., Mobile, Ala., as Instrumentman, Jun. Engr., and Res. Engr.

Caster, Arthur Dawson (Junior), Indianapolis, Ind. (Age 31) (Claims RCA 6.1) Aug. 1938 to Oct. 1939, Field Engr., Jan. to Nov. 1941, Asst. Engr., and Jan. 1942 to date, Designing Engr., with Charles H. Hurd, Archt.-Engr.; in the interim Asst. Engr. for Morganfield, Ky., Archt.-Engr. on proposed army camp; Plumbing Engr., U.S. Engr. Dept., Asst. Engr. with H. P. Jones Co., and Supt. of New Castle sewage-treatment works.

Champion, Robert Louis, Evanston, Ill. (Age 28) (Claims RCA 2.0) 1941 to date with The Technological Inst., Northwestern Univ., Dept. of Civ. Eng., teaching drafting, cost estimating, etc.; previously teaching at Michigan State Coll., Woodstock (Ill.) Community High School, and Univ. of Illinois, C.H.S.

Cosgrove, John Daniel, 2d, New Castle, Del. (Age 38) (Claims RCA 10.1 RCM 2.2) June 1941 to date Associate Engr. and Supt. of Constr., Office of Dist. Engr., U.S. War Dept., Philadelphia, Pa.; May 1940 to June 1941 Engr. and Gen. Supt., Jes Dall, Jr., Inc., Ithaca, N.Y.; previously Asst. Res. Engr. Inspector, PWA, New York City; Engr. and Asst. Gen. Supt. with John D. Cosgrove, Civ. Engr., Inc., Glen Cove, N.Y.

Crout, Jesse Webb, Jackson, Miss. (Age 38) (Claims RCA 11.5) May 1942 to date Engr. of Estimates (Asst. to Coordinator), H. B. Deal Co., Inc., Ozark Ordnance Works, El Dorado, Ark.; previously with Sanderson & Porter, and Black & Veatch, Engrs. and Contrs.; Project Engr., Municipal Airport, WPA, Jackson, Miss.; Engr., Lockwood Greene Eng. Co., etc.

Dunham, Cecil, Barcelona, Venezuela. (Age 34) (Claims RCA 3.7) Jan. 1937 to date with Mene Grande Oil Co., Maracaibo office, in various capacities, since Jan. 1941 with eastern organization of company at Barcelona, having charge of drafting room and estimating for Constr. Eng. Dept.

Evans, John Joseph (Junior), Charleston, S.C. (Age 28) (Claims RCA 2.9 RCM 1.5) Oct. 1938 to date Detailer to Designing Engr., Harza Eng., Co.; previously with TVA, Knoxville, Tenn.

Frank, Robert Gordon, Colorado Springs, Colo. (Age 32) (Claims RCA 7.1) Feb. 1942 to date Office Engr., U.S. Engrs.; Dec. 1941 to Feb. 1942 Detailer, Wyatt C. Hedrick, Archt.-Engr., Belton, Tex.; previously with Fisher, Fisher & Hubbell and Paulette & Wilson, Archt.-Engrs.

Griffith, James Robert, Jr., Atlanta, Ga. (Age 36) (Claims RCA 5.8) Oct. 1940 to June 1941 Capt., and June 1941 to date Major, Corps of Engrs., U.S. Army; previously Jun. Engr., and Asst. Engr., U.S. Engr. Office, War Dept., Vicksburg, Miss.

Groves, John Meybin (Junior), Ancon, Canal Zone. (Age 32) (Claims RCA 3.1 RCM 1.1) May 1939 to date with Special Eng. Div., The Panama Canal, as Asst. Hydr. Engr., Hydr. Laboratory, and (since June 1941) Associate Engr., Protection Section Laboratory; previously with TVA.

Grow, Virgil Byron, Jr., Richmond, Va. (Age 35) (Claims RCA 8.0) Oct. 1936 to date Field Engr., Portland Cement Association.

Hassilev, Leonid, New York City. (Age 40) (Claims RCA 8.2) Feb. 1942 to date Designing Engr., The Foundation Co.; previously Asst. Chf. Designing Engr., Desplats & Lefefre, Paris, France.

Hendrick, Jasper Reginald (Junior), Panama City, Fla. (Age 28) (Claims RCA 3.3 RCM 0.9) Dec. 1941 to date with U.S. Engrs., Mobile Dist., as Asst. to Area Engr., and (since May 1942) Area Engr.; Dec. 1940 to Dec. 1941 with U.S. Army on special duty; Field Engr. with Kook and Fowler, Cons. Engrs., Brownwood, Tex.; with WPA, San Angelo, Tex., as Jun. Office Engr.; with Hawley, Freese and Nichols, Cons. Engrs., Ft. Worth, as Inspector and Res. Engr.

Hogue, Wilbur Owings, Pocatello, Idaho. (Age 32) (Claims RCA 6.4 RCM 0.7) Oct. 1937 to June 1942 Field Engr. and Constr. Supt., Firestone Plantations Co., Monrovia and Cape Palmas, Liberia.

Jared, John Ballard, Jr. (Junior), Beaumont, Tex. (Age 28) (Claims RCA 1.5) 1936 to date with American Petroleum Co. of Texas (since Jan. 1942 American Republic Corporation), in various capacities; since April 1942 as Office Engr. and Asst. Designer.

Knox, Vernon Eugene (Junior,) Caracas, Venezuela. (Age 32) (Claims RCA 6.0) March

1937 to date Field Engr., Exploration Dept., Standard Oil Co. of Venezuela.

Krakow, Herbert, New York City. (Age 35) (Claims RCA 9.0 RCM 2.2) 1928 to date with City of New York, as Eng. Asst. and Jun. Engr., Board of Transporation, Topographical Draftsman, Grade 4, Bureau of Street Openings, Corporation Counsel, and (since 1938) Transitman, Asst. Engr., Grade 4, Pres., Borough of Manhattan.

Leeper, Robert Fulton, Chicago, Ill. (Age 42) (Claims RCA 12.3 RCM 2.9) July 1939 to date with U.S. Engr. Dist. Office, Chicago, Ill., as Jun. Engr. (Civil), Asst. Engr. (Civil), and (since Oct. 1941) Asst. Engr. and Associate Engr. (Civil); previously with U.S. Engr. Area Office, Blue Island, Ill., as Inspector and Jun. Engr. (Civil).

Long, William Frederick (Junior), Bozeman, Mont. (Age 28) (Claims RCA 2.7 RCM 4.3) June 1935 to May 1942 with U.S. SCS in various capacities, after March 1942 as Project Engr. in charge of Holland Settlement-Willow Creek soil and moisture demonstration project; at present with U.S. Army.

Maziarz, Edward Francis, Brookfield, Ill. (Age 39) (Claims RCA 5.8) Sept. 1936 to date with Aluminum Co. of America, Pittsburgh, Pa. as Asst. to Supt., and (since Sept. 1938) Supt. of Constr.

Medler, Samuel Watson, Chattanooga, Tenn. (Age 36) (Claims RCA 5.9) Jan. 1941 to date with Stone & Webster Eng. Corporation, as Structural Supervisor, Piping Supervisor, and (since Dec. 1941) Structural Supervisor, Div. No. 7, TNT area; previously Engr. and Contr.; Inspector, Metropolitan Sewerage Comm. of Milwaukee; with Wisconsin Highway Comm., Div. No. 2.

Mohr, Lawrence Gustav (Junior), Philadelphia, Pa. (Age 32) (Claims RCA 2.4) May 1937 to date with U.S. Engr. Dept., as Surveyman, Inspector, Soils Technician, Asst. Engr., and (since Dec. 1941) Asst. and Associate Engr.

Morey, Arthur Paine, Kansas City, Mo. (Age 41) (Claims RCA 15.3) Jan. to Dec. 1941 Asst. Civ. Engr., Smith, Hinchman & Grylls, Inc., and Dec. 1941 to date Asst. Maintenance Engr., Remington Arms, Inc., on Lake City Ordnance Plant; previously Res. Engr., C. L. Berger Eng. Co.; Res. Engr., Black & Veatch, Cons. Engrs.

Moser, Earl Hampton, Jr., Albuquerque, N. Mex. (Age 27) (Claims RCA 2.1) Jan. 1935 to date with Sedimentation Div., SCS, Washington, D.C., as Rodman, Asst. Eng. Field Aide, Eng. Aide, Jun. Civ. Engr., and (since May 1940) Asst. Civ. Engr.

Ogilvie, Lemuel Bynum, Barcelona, Venezuela. (Age 40) (Claims RCA 6.0 RCM 3.5) Jan. 1938 to Feb. 1940 Asst. Chf. Engr., and Feb. 1940 to date Chf. Engr., Mene Grande Oil Co.; previously with Parker Bros. & Co., Inc., Houston.

O'Harrow, Henry Dennis, Omaha, Nebr. (Age 33) (Claims RCA 5.7 RCM 1.9) April 1939 to date with National Resources Planning Board, as Associate Planning Technician and Planning Technician; previously Asst. Chf. Draftsman, Director of Housing Research and Director of Research for State Planning Board of Indiana.

Porter, Malcolm Marion, Crawfordsville, Ind. (Age 37) (Claims RCA 11.5) Oct. 1933 to date with Indiana Highway Comm., as Project Engr., and (since July 1939) Asst. Dist. Engr. of Bridges.

Press, Emil Asmus Severin, Washington, D.C. (Age 37) (Claims RCA 5.1 RCM 3.0) Feb. 1923 to date with Govt. of District of Columbia as Draftsman, Instrumentman, and Chf. Eng. Draftsman, Sewer Div., and (since July 1935) Asst. to Director of San. Eng., Eng. Dept.

Rigsbee, Herbert Kenneth (Junior), Knoxville, Tenn. (Age 31) (Claims RCA 3.0) Dec. 1941 to date Jun. Highway Engr., TVA; June 1940 to Dec. 1941 with Texas Highway Dept., as Rodman and Instrumentman; previously Project Supt. on flood-control and highway work.

Rodgers, Theodore Wiechen, Sacramento, Calif. (Age 33) (Claims RCA 5.9) Oct. 1935 to date with Bridge Dept., California Div. of Highways, Dept. of Public Works, as Senior Eng. Aide, Jun. Bridge Engr., and (since May 1941) Asst. Bridge Engr.

Ryan, Robert Laurence, Santa Paula, Calif. (Age 48) (Claims RCA 11.6 RCM 9.0) Jan. 1935 to date County Surveyor, Ventura County, Calif.

Sandals, Kirk Monroe, Brookings, S.Dak. (Age 33) (Claims RC 3.5) April 1937 to date with Water Utilization Sec., Bureau of Agri. Economics, U.S. Dept. of Agriculture, as Asst. Engr., Associate Water Planning Analyst, and (since April 1942) Water Planning Analyst (P-4).

Seburn, Thomas James, Kansas City, Mo. (Age 39) (Claims RCM 11.5) Dec. 1930 to date City Traffic Engr., Kansas City, Mo.

Shapiro, Salem S, Forest Hills, N.Y. (Age 33) (Claims RCA 7.0) 1928 to date with City of New York successively with Dept. of Docks, Board of Transportation, Pres. of Borough of Queens, Topographical Bureau, and (since 1939) with Planning Comm.

Stern, Ernest George (Junior), Blacksburg, Va. (Age 29) (Claims RCA 3.0 RCM 1.0) July 1941 to date Research Engr., Eng. Experiment Station, Virginia Polytechnic Inst.; previously Graduate Asst., and Research Asst., Eng. Experiment Station, Pennsylvania State Coll.

Stine, William Virgil (Junior), Ashland, Ohio. (Age 31) (Claims RCA 6.2) Jan. 1934 to date with Ohio Dept. of Highways as Asst. Engr., and (since May 1936) Materials Engr.

Sweet, Charles Alvin (Junior), Honolulu, Hawaii. (Age 32) (Claims RCA 3.9) Feb. 1940 to date with Pacific Naval Air Base Contrs., as Chf. of Survey Parties and Field Engr., and (since Aug. 1941) Project Engr.; previously with Atchison, Topeka & Santa Fe Ry.; Metropolitan Water Dist. of Southern California.

Trostle, Nevin Elmer, Temple, Tex. (Age 40) (Claims RCA 7.2 RCM 0.4) Sept. 1936 to date City Engr., Temple, Tex.

Tulley, Patrick Eugene, Diablo Heights, Canal Zone. (Age 31) (Claims RCA 3.9 RCM 0.9) Dec. 1941 to date with Special Eng. Div., The Panama Canal, as Prin. Eng. Aide, and (since April 1942) Chf. Eng. Aide; Aug. to Dec. 1941 with Paulette and Wilson (Wilson and Co., Engrs.), as Instrumentman and Party Chf.; previously with Colorado Highway Dept.

Viertel, George Joseph (Junior), Hampton, Va. (Age 30) (Claims RCA 4.7) Jan. to Dec. 1941 Asst. Constr. Engr., and Dec. 1941 to date Associate Constr. Engr., National Advisory Comm. for Aeronautics, Langley Field, Va.; previously Eng. Asst., Board of Water Supply, New York City; Supt. of Constr., M. Shapiro & Son, New York City.

APPLYING FOR JUNIOR

Bergquist, Gustav Harry, Chicago, Ill. (Age 30) April 1942 to date Stress Analyst, Goodyear Aircraft Corporation, Akron, Ohio; Dec. 1940 to April 1942 San. Engr., Chicago Pump Co.; previously Jun. Civ. Engr., City of Evanston, Ill.; Fire Inspection Engr., Chicago Board of Underwriters.

Engebretson, Wilbur C., Seattle, Wash. (Age 32) (Claims RCA 1.2) May 1937 to date with U.S. Engr. Office, as Instrumentman, Recorder, Party Chf., Office Computer, and (since May 1941) Asst. Engr., Structural Design Sec.

Frink, John Westlake, Guild, Tenn. (Age 26) Sept. 1941 to date with TVA, as Geologic Aid, and (since Jan. 1942) Jun. Geologist; previously graduate student, Louisiana State Univ., and Univ. of Cincinnati.

Kollar, Konstantine Louis, Hinton, W.Va. (Age 25) Oct. 1940 to date Jun. Engr., U.S. Geological Survey, Washington, D.C.; previously Topographical Draftsman, Climate Crop Weather, Branch of Weather Bureau; Instrumentman, Park Dept., New York City.

Lingham, Carlton Wiltse, Ocala, Fla. (Age 31) March 1936 to May 1937, March 1938 to date with U.S. Geological Survey as Recorder, Jun. Engr., and (since Nov. 1940) acting as Office Asst.

Monson, Lyle Edward, Malvern, Ark. (Age 29) 1940 B.S. in Civ. Eng., Univ. of Wis.; Feb. 1941 to date Field Engr., Erecting Dept., American Bridge Co., Chicago, Ill.; previously Reinforcing Checker with Joseph T. Ryerson & Son, Chicago.

Rhodes, James Arthur, Savannah, Ga. (Age 27) (Claims RC 0.9 D 0.2) Jan. 1942 to date Asst. Engr. (Hydr.), U.S. Engrs., War Dept.; Dec. 1939–Dec. 1941 Jun. Agri. Engr., SCS, U.S. Dept. of Agriculture; previously with Wisconsin Highway Comm.

Shu, Paul Clifford, Tuscaloosa, Ala. (Age 26) 1940 B.S. in C.E., Va. Mil. Inst.; June 1940 to date Student Apprentice, Southern Ry. System.

Smith, Richard Alonzo, Washington, D.C. (Age 25) Aug. 1938 to date (except Sept. 1939 to Aug. 1940 student) with U.S. Engr. Dept., Office of Dist. Engr., as Draftsman (Topographic), and (since Feb. 1941) Asst. Engr.; previously Draftsman (Topographic), SCS, U.S. Dept. of Agriculture, Ruston, La.

Wilson, Robert Roy, Grenada, Miss. (Age 32) Oct. 1941 to date with War Dept., Huntsville (Ala.) Arsenal, as Associate Engr.; previously with Schultz & Norton, Archt. Engrs., Memphis Gen. Depot, Darin & Armstrong Co., DuPont Co., The Tennessee Powder Plant and The Charlestown (Ind.) Powder Plant; Asst. Project Engr., WPA; with Young & Maury, Bldrs.

Winberg, Gus Jackson, Stockton, Calif. (Age 31) 1940 B.S. in Eng., Univ. of Calif.; Sept. 1940 to May 1942 Jun. Engr., U.S. Bureau of Reclamation; at present with Standard Bldg. Co. as Asst. Supt. of Constr., Stockton Flying School.

1941 GRADUATES

MANHATTAN COLL.
(B.S. in C.E.)

	Age
Houlihan, Daniel Joseph	(22)

UNIV. OF MINN.
(B.C.E.)

Laursen, Emmett Morton	(23)

1942 GRADUATES

ALA. POLY. INST.
(B.S. in Civ. Eng.)

Bolon, Leslie Wilson	(23)
Diegel, Archie William, Jr.	(22)
Gregory, William Edmund	(25)
Lee, John Holmes, Jr.	(23)
Phipps, John Mandeville	(21)
Rainey, Henry Frederick	(22)
Stanfield, Robert Clifford, Jr.	(23)
Tobey, Frank Thrall, Jr.	(24)

UNIV. OF ALA.
(B.S. in C.E.)

Ellis, Elon Ellsworth	(21)
Hansen, Philip Charles	(32)
Jowers, Afton Bradford	(24)
Leskowitz, George Joseph	(22)
Miller, William Ellsworth	(29)

UNIV. OF ARIZ.
(B.S. in C.E.)

Brown, Leonard Norway	(21)
Gittings, Elisabeth Fisher (Mrs.)	(22)
Hamilton, George Rogers	(22)
Johnson, John McGill	(24)

UNIV. OF ARK.
(B.S.C.E.)

McCrary, Louis Coleman	(25)

BROOKLYN POLY. INST.
(B.C.E.)

Beer, Stanley William	(22)
Billings, Herbert Joseph	(21)
Bruns, Robert Bruce	(21)
Dribben, Joseph	(24)
Korwasky, Joseph	(27)
MacDonald, George Ewen	(21)
Pool, William Harrison	(21)
Posillico, James	(21)
Schwarting, Diedrich Drayton	(23)
Spector, George	(22)
Thompson, Russell Snow	(21)

BROWN UNIV.
(Sc.B. in Eng.)

Clark, Andrew Sellars	(22)
Simmons, Desmond Leverock	(20)

BUCKNELL UNIVERSITY
(B.S. in C.E.)

Kordish, Emil	(21)
McGuire, William	(21)
McPherson, Murray Burns	(22)
Mann, Normal Russell	(20)
Williams, Bennett Good	(22)

CASE SCHOOL OF APPLIED SCI
(B.S. in C.E.)

Barton, Roland Neal	(22)
Frerich, William Robert	(21)
Hanley, Daniel Forbes	(22)
Kemper, Robert Martin	(21)
McLaughlin, Gurney Edward, Jr.	(21)
Rapp, Edward George	(22)
Roy, Donald John Alfred	(21)
Thoman, John Richard	(21)

UNIV. OF CIN.
(C.E.)

LeGrand, Harold William	(29)

THE CITADEL
(B.S. in C.E.)

Anderson, George Bayles	(22)

CLARKSON COLL. TECH.
(B.C.E.)

Fowler, Harry Charles	(21)
Lawton, Carl William	(23)
Stutzman, Charles Arthur	(21)

CLEMSON COLL.
(B.C.E.)

Ellis, Ralph Henry	(20)
Hooks, Arthur Vance, Jr.	(20)
McTeer, Thomas Albert	(21)
Parker, Thomas McCutchen	(20)
Poe, William Nelson	(21)
Rabb, James MacMillan, Jr.	(21)
Salter, James Crisp Akers	(22)
Terry, John Russel, Jr.	(20)
White, William Crawford	(21)

UNIV. OF COLO.
(B.S. in A.E.)

Punshon, Elmer Thomas	(21)
Williams, Nolan Harold	(21)

(B.S. in C.E.)

Alden, Lee Halbert	(22)
Bashore, Harry William, Jr.	(21)
Crowe, Stanley Reed	(22)
De Clue, John Raphael, Jr.	(21)
Dwyer, Charles Francis	(21)
Gordon, Malcolm Lane	(23)
Haddon, Harold George	(22)
King, Raymond Jesse, Jr.	(23)
Kuntz, Guy Theodore, Jr.	(20)
Nordeen, Leonard Oliver	(22)
Putnam, Howard Edward	(21)
Settergren, Robert George	(22)
Traxler, Robert Wingate	(21)
Westfall, Millard Frank	(22)
Whyte, Norman James	(25)
Wood, Douglas Purdue	(22)
Wright, William Richard	(21)
Ziegelmeier, Milton Allen	(22)

(M.S. in C.E.)

Wang, Chu-Kia (Also 1938 B.S. in C.E., St. John's Univ., Shanghai)	(25)

UNIV. OF CONN.
(B.S. in C.E.)

Andrews, Malcolm George	(21)
Griswold, Albert Homewood	(21)
Hawkins, Stewart DeWitt	(24)
Medbury, Arnold Holmes	(22)

CORNELL UNIV.
(B.C.E.)

Simpson, Howard	(20)

DARTMOUTH COLL. THAYER SCHOOL OF ENG.
(B.S. in C.E.)

Barr, Robert Thompson	(23)
Nevius, Martin Leroy	(24)

UNIV. OF DAYTON
(B.C.E.)

Brennan, John Joseph	(22)
Covarrubias, Javier, Jr.	(22)
Igel, Joseph Anthony	(22)
Schulkers, Joseph Robert	(21)

DUKE UNIV.
(B.S. in C.E.)

Fleming, Clifford Neal	(21)

UNIV. OF FLA.
(B.C.E.)

Bennett, John Wray	(21)
Logan, Claude Duvual, Jr.	(23)
Telfair, John Spier, Jr.	(26)
Van Clief, William Carroll, Jr.	(23)

GA. SCHOOL TECH.
(B.S. in C.E.)

Belcher, Clarence Edward	(22)
Miller, George Erikson	(24)
Quillian, Hugarwyn	(21)
Steimer, Theodore George	(23)

ILL. INST. TECH.
(B.A. in C.E.)

Leibrandt, Raymond Schieber	(24)

(B.S. in C.E.)

Tachau, Herman	(21)

UNIV. OF ILL.
(B.S. in A.E.)

Broyles, Mendel Maurice	(24)
Fruehauf, Paul Adam, Jr.	(22)
May, Arnold Nicholas	(25)
Nelson, Paul Olof	(24)
Pryma, Leo George	(32)
Tang, Stephen Jen Yao	(23)
Viger, James William	(23)

(B.S. in C.E.)

Atkins, Clinton Paul	(32)
Barsh, Norman	(22)
Munse, William Hermann, Jr.	(22)
Porter, James Ashbel	(24)
Raiche, Wallace James	(25)
Sandberg, Harold Raymond	(22)

STATE UNIV. OF IOWA
(B.S. in C.E.)

Burger, Warren Francis	(22)
Weikel, Clarence Elmer	(24)

KANS. STATE COLL.
(B.S. in C.E.)

Bennett, Philip Frank	(26)
Gilles, Robert Albert	(22)
McEntyre, John Gerald	(21)
Meeks, Arthur Fred	(21)
Noble, Norman Lynn	(24)
Stockebrand, Victor Dale	(23)
Sutherland, William L	(24)
Wilkes, James Harley	(31)

UNIV. OF KY.
(B.S. in C.E.)

Guthrie, Harvey Logan	(28)
Ligh, Harry Kuo-Deng	(21)

UNIV. OF LOUISVILLE
(B.C.E.)

Hancock, John David	(22)
Haynes, Kenneth Frederick	(23)
Kuchar, Arthur Morgan	(21)
Schaap, Earl Henry (Also 1935 A.B.)	(29)

UNIV. OF MAINE
(B.S. in C.E.)

Bacon, Henry Ferdinand	(22)
Ingraham, Mark Whitmore, Jr.	(21)

MARQUETTE UNIV.
(B.C.E.)

Schaefer, Charles Alvin	(23)

MASS. INST. TECH.
(S.B.)

Cavanaugh, David James	(22)
Crandall, Paul Stuart	(22)
Gartland, Edward Vincent, Jr.	(21)
Hall, Charles Loring, Jr.	(22)
Krucklin, Robert Elmer	(23)
Kustowski, Julian	(26)
Lawrance, Charles Holway	(21)
Levere, Bernard	(20)
Mulvaney, John Joseph	(21)
Stansfield, Donald Hitchen	(22)

UNIV. OF MINN.
(B.C.E.)

Berg, Jerome Orlando	(24)
Dienhart, Arthur Vincent	(21)
Erickson, Neil Rodney	(24)
George, Leo Lanfall	(25)
Jensen, Ivan Raymond	(22)
McConnell, Clifford Harvey	(24)
Sargent, Walter Howard	(23)

UNIV. OF MISS.
(B.S.C.E.)

Baughn, Jacob Charles	(25)
Bryan, Harry Meredith, Jr.	(24)

MO. SCHOOL OF MINES AND MET.
(B.S. in C.E.)

Beard, Mark Wallace	(22)
Cutler, Robert Roscoe, Jr.	(25)
Pollock, William Lee	(21)
Trotter, Charles Richard	(31)

NEWARK COLL. OF ENG.
(B.S. in C.E.)

Brendler, Arthur William	(21)
Del Vecchio, Philip	(21)
Donald, David Stewart	(27)
Greitzer, Milton Schwartz	(20)
Michak, Lawrence	(21)
Shalit, Benjamin Barry	(21)

UNIV. OF N.H.
(B.S. in C.E.)

Burroughs, Robert Bernard	(21)
Duclos, Francis George	(28)
Hastings, Raymond Isham	(24)
McCrone, Henry Richmond, Jr.	(22)
Poor, Ernest Raymond	(21)

N.MEX. STATE COLL.
(B.S. in C.E.)

Maddox, Robert Logan, Jr.	(22)

COLL. OF CITY OF N.Y.
(B.C.E.)

Boyle, Frank William	(21)
Dember, Seymour	(21)
Fenton, Richard	(22)
Klurfeld, Samuel	(20)
Laub, David	(21)
Rodriguez, Louis	(21)
Savitsky, Daniel	(20)

N.Y.U.
(B.C.E.)

Campbell, George Prentiss	(22)
Obler, Edward	(24)
Pon, Charles Louis	(23)
Shore, Herbert	(21)
Tauscher, Arthur	(21)
Wasil, Benjamin A.	(22)
Wesp, Edward, Jr.	(22)

N.C. STATE COLL.
(B.C.E.)

Carney, James Franklin	(27)
Foushee, John Giles	(23)
Hamby, Edward Paul	(22)
Lambe, Thomas William	(21)
Reed, Roy Lee	(23)
Smith, James McCree	(25)
Stout, Paul Eli	(22)
Williams, Lonnie Crump, Jr.	(22)

N.DAK. AGRI. COLL.
(B.S. in C.E.)

Guldemann, Eugene Josslyn	(28)

OHIO NORTHERN UNIV.
(B.S. in C.E.)

Baird, Merle Delton	(26)
Brown, David Charles	(23)
Durey, John H	(24)

UNIV. OF OKLA.
(B.S. in C.E.)

Bardwell, David William	(21)
Blair, Percy Fox	(22)
Bond, Ike Bert	(23)
Comer, Alton Byrd	(22)
Hayes, Edward Wallace	(24)
Moore, Thomas Calvin	(22)
White, Lewis Homer	(21)

UNIV. OF PA.
(B.S. in Civ. Eng.)

Huston, James Francis, Jr.	(22)

UNIV. OF PITTSBURGH
(B.S. in Civ. Eng.)

Elliott, James Henry	(21)

PURDUE UNIV.
(B.S. in C.E.)

Ahlvin, Martin Alder	(24)
Bremerman, Dale Vincent	(21)
Brown, Walter Albert, Jr.	(22)
Cadwallader, Ira	(23)
Canham, Robert Allen	(21)
Captain, Lewis Everett	(24)
Cohen, Arthur Aaron	(23)
Darling, William Amstutz	(22)
Fant, Jesse Ernest	(24)
George, Arthur Wayne	(24)
Glazer, Irving Harold	(21)
Hall, Robert Lyman	(21)
Hawley, John Armitage	(21)
Helmich, John Edward	(21)
Herbold, Carl James, Jr.	(22)
Higman, Ralph Kreigh	(23)
Hittle, Jean Edwin	(25)
Kallstrom, Charles Edward	(22)
Katz, Allen Marvin	(21)
Killin, Wilbur Charles	(30)
Largent, William Henry	(29)
Lux, Kathleen Fanchion (Miss)	(21)
MacDowell, Robert Ashbrook	(21)
Miller, Lloyd Wendell	(22)
Ohman, Warner	(26)
Pluciennik, Edmond Richard	(22)
Reid, George Willard	(24)
Schalck, Walter Stanley	(21)
Shields, Thomas George	(22)
Truitt, Harry Hyde	(22)
Warren, Donald Clifton	(21)
Williams, Robert Angus	(21)
Yoder, Thomas Wayne	(21)

RENS. POL. INST.
(B.C.E.)

Barry, Benjamin Austin (Brother, F. S. C.) (Also A.B., Catholic Univ. of America.)	(24)
Boyce, Gifford Raymond	(21)
Cavanaugh, Thomas George, Jr.	(22)
Ferretti, Henry Louis	(21)
McCabe, Joseph (Brother, F.S.C.) (Also 1935 A.B., Catholic Univ. of America)	(28)
Parker, Jay Bortle	(22)

(M.C.E.)

Barker, Joseph Henry, Jr. (Also 1941 B.C.E., Rens. Poly. Inst., and 1936 B.S., U.S. Naval Acad.)	(27)

Hartman, Herbert Joyce (Also B.C.E., Rens. Pol. Inst., and B.S., U.S. Naval Acad.)	(27)

R.I. STATE COLL.
(B.S. in C.E.)

Corsi, Louis	(21)
Daley, Austin Christopher	(24)
Hammond, Richard Coleman	(22)
Kozak, John Joseph	(21)
MacKinnon, Noel Spencer	(21)
Rohland, Curt John, Jr.	(22)
Sakakeeny, Anthony	(22)
Sweeney, Edward Joseph	(22)
Sweet, Richard Walter	(23)

ROSE POL. INST.
(B.S. in Civ. Eng.)

Bowsher, Harold Eugene	(22)
Brown, James Rae	(22)
Chalfant, Ray King, Jr.	(21)
Johnson, Arthur, Jr.	(21)
Meurer, Charles Samuel	(21)
Rockwood, Robert William	(21)

RUTGERS UNIV.
(B.S. in Civ. Eng.)

Gordon, George	(21)
Maguire, Frank Gregory, Jr.	(22)

UNIV. OF S.C.
(B.S. in C.E.)

Hinson, Francis Marion, Jr.	(22)

S.DAK. STATE SCHOOL OF MINES
(B.S. in C.E.)

Downes, Harold John	(20)

STANFORD UNIV.
(A.B. in Eng.)

Silva, Melvin Francis	(23)

SYRACUSE UNIV.
(B.C.E.)

Roland, John James	(22)
Schantz, John Cosler	(24)
Waller, Eric Wenborne	(23)
White, Floyd Eric	(21)

TEX. A.&M. COLL.
(B.S. in C.E.)

Anderson, Albert Edwin	(26)
Barber, Bert Dillon	(23)
Cavender, William Dennis, Jr.	(24)
Creel, Henry Grady, Jr.	(20)
Davis, William Carr, Jr.	(20)
DuBose, Lawrence Addison	(21)
Fisher, Floyd Seth, Jr.	(21)
Geer, Gene Marion	(22)
Goldston, James Maxey	(21)
Hardeman, Thomas Nash	(21)
Horton, Ernest Layfette, Jr.	(22)
Melcher, Max Allen	(22)
Muse, Edward Clayton, Jr.	(21)
Pettigrew, Jim Moore	(20)
Prejean, Wilton John	(21)
Rascoe, William Marion	(21)
Reagan, John Woodrow	(25)
Santoni, Eugenio Luis	(22)
Schaefer, Charles Albert	(22)
Sears, L A	(21)
Stearman, William Clarence, Jr.	(22)
Swigert, William Fielding	(25)
Teague, Jesse Ardell	(21)
Timmons, Edmond Amplias	(23)
Towery, Pat	(21)
Walker, Charles Leroy	(23)
Williams, James Henry	(22)

TUFTS COLL.
(B.S. in Civ. Eng.)

Watts, Albert Fraser	(22)

UNION COLL.
(B.S. in C.E.)

Brockwehl, Donald Robert	(21)
Jakobowski, Benjamin, Jr.	(22)
Rifenbark, Harry Edward	(21)
Stillman, William James	(23)

UNIV. OF UTAH
(B.S. in C.E.)

Anderson, Royal Paine	(22)
Brubaker, Joseph Junior	(24)
McKellar, George Woodrow	(25)
Neff, John Elwood	(21)
Souther, William Homer	(23)
Storrs, Dean Scott	(23)
Talbot, Sterling John, Jr.	(24)

UTAH STATE AGRI. COLL.
(B.S.)

Budge, Khalil McKay	(23)
Christiansen, Lyman Marion	(28)
Dalley, Parley James	(23)
Heaton, Norman Isom	(24)
Johnson, Preston Dalley	(20)
Morgan, Wayne Rich	(23)
Olsen, Newell Preston	(23)
Petersen, Mervin Seamons	(22)
Rose, Willard Cozier	(24)
Wilson, Robert Folsom	(21)

VA. MIL. INST.
(B.S. in C.E.)

Cabell, Paul Carrington	(22)
Chewning, Charles Carpenter	(21)
Drake, Chester Myrick, Jr.	(21)
Fogarty, Edward John, Jr.	(22)
Heindl, Louis Armistead, Jr.	(21)
King, Edwin Vernon	(21)
Lewis, Robert Augustus	(21)
Littlejohn, Erik Price	(22)
Moore, Gordon Eldridge	(22)
Thornton, Herbert Marshall	(23)
Tipton, Harold Glenn	(22)
Vick, Alfred, III	(21)
Williams, Alexander Hutcheson	(21)
Wright, John Martin	(21)

VA. POL. INST.
(B.S. in C.E.)

Agnew, John Park, Jr.	(21)
Brockenbrough, Thomas William	(21)
Davis, Wallace Greene	(22)
Hurtado, Luis Ernesto	(21)
Sutton, Sherwood Adelbert	(22)

UNIV. OF WIS.
(B.S. in Civ. Eng.)

Elliott, John Frederick	(24)
Luebke, Robert Erwin	(22)
Tice, Clifford James	(21)

WORCESTER POL. INST.
(B.S. in Civ. Eng.)

Bellassai, Salvatore John	(21)
Disario, Paul Carmen, Jr.	(22)
Ford, John, Jr.	(21)
Hartwell, David Lawrence	(21)
Oneglia, Francis Joseph	(21)
Robjent, James Frederick	(24)
Searles, Robert Wallace	(22)
Williams, Samuel Wesley, Jr.	(21)

YALE UNIV.
(B.S. in C.E.)

Anderson, Charles Adolph Rosell	(28)
Brooks, Charles Carroll	(21)
Dell, Harold Kleiber, Jr.	(22)
Ingraham, Irving Edward	(22)
Kranichfeld, Henry Charles, Jr.	(23)
Lathrop, Robert Penfield	(20)
MacLeman, Everett Louis	(24)
Ver Planck, Warburton King	(22)

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Engineering Societies Personnel Service, Inc.

New York	Chicago	Detroit	San Francisco	Boston
31 W. 39th St.	211 W. Wacker	Farnsworth Ave.	57 Post St.	4 Park Street

The items listed below have been furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the Four Founder Societies. This service is available to members and is operated on a cooperative, non-profit basis. In applying for positions advertised by the Service the applicant agrees, if actually placed in a position through the Service as a result of these advertisements, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient, non-profit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office.

A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription of $3 per quarter or $10 per annum, payable in advance.

MEN AVAILABLE

Graduate Civil Engineer; Jun. Am. Soc. C.E.; 22; married; 1 year of experience in structural steel detailing; prefer field work or part-time in field work near New York City. Will travel. Available on two weeks' notice. C-925.

Civil and Sanitary Engineer; M. Am. Soc. C.E.; 50; graduate of M.I.T.; citizen; married; licensed in New Jersey; technical and administrative experience in water supply, sanitation, flood control, sewerage, malaria control, drainage and erosion control, soil conservation, water supply appraisals and rates, and general engineering. Available immediately. C-926.

Graduate Civil Engineer; Jun. Am. Soc. C.E.; 28; single; 3 years laying out, constructing, and inspecting water channels and earth structures, drafting, computing, and drawing plans; 2 years physical testing personnel for special aptitudes. Desires direction of physical testing laboratory including experimental work or varied field and office engineering supervision and planning. C-927.

Graduate Civil Engineer; M. Am. Soc. C.E.; over 30 years' experience in design, construction, operation, and management of water, gas, and electric utilities. Specialty, water and sewerage systems for municipal and private corporations and for cantonment. Consultant for utilities for many U.S. Army posts in East; desires position as an executive. C-928.

Instructor; Assoc. M. Am. Soc. C.E.; desires position as assistant professor of surveying or sanitary engineering; several years' teaching surveying and drawing. Master's degree and some teaching in sanitary engineering. C-929.

POSITIONS AVAILABLE

Senior and Junior Engineers, graduate civil, or possibly mechanical, engineers, with training or experience in public administration, preferably in design or construction of municipal public works. Should have good working knowledge of principles and practices of civil engineering, of the theory and practices of land surveying, construction methods and procedures, engineering computations and estimates, and have ability to supervise work of others. Must have statement of deferred draft status. Salaries: Junior, $1,920–$2,280 a year; Senior, $2,400–$2,760 a year. Location, New Jersey. W-235.

Cost Engineers, 45–50, who can work up costs for buildings and heavy construction. Salary open Locations, British Guiana and Trinidad. W-241.

Assistant Construction Engineers, 30–35, graduates, who have had considerable experience on highway construction, drainage, excavation, etc. Will be required to assist construction superintendent making reports, etc. Duration, 6 to 10 months. Salary, $6,000 a year. Location, South America. W-291.

Designers for structural work of all kinds. Company needs structural, electrical, and mechanical men; engineer who has had wooden trestle work also desirable. Location, South. W-292.

Draftsmen, structural, mechanical, and electrical engineers, not over 55, for detailing operations on marine work. Experience in hull, ship layout, or outfitting desirable. Salary, up to $4,800 for a 40-hour week. Location, western Pennsylvania. W-320.